Antecedents and Consequences of Dynamic and Entrepreneurial Capabilities: An Empirical Examination of UK High-Tech SMEs

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Declaration of Authorship

I Prabhashwara Chaminda Senaratne hereby declare that this thesis and the work presented in it is entirely my own. Where I have consulted the work of others, this is always clearly stated.

Signed:

Date :

Abstract

This study addresses the problem how firms achieve differential firm performance, which has been central to the strategic management discourse. Specifically, the study examines the nature, antecedents and consequences of firms' dynamic capabilities (DCs) and entrepreneurial capabilities, based on the resource-based view of the firm. The effects of the success trap as an internal antecedent and market dynamism as an external antecedent of DCs, the effects of DCs on entrepreneurial capabilities, and consequently on firm performance are tested.

The study adopts a two-stage research design. Firstly, the quantitative study was the predominant research design. A mail survey generated 113 effective responses from UK SMEs across five high-tech industries. The key research constructs were subjected to exploratory factor analysis and the hypotheses were tested using correlation analysis and hierarchical regression analysis. Secondly, a qualitative study complemented the quantitative study. 20 semi-structured interviews were conducted with senior executives of 20 firms which also participated in the survey. The qualitative data were used to explain the quantitative findings.

The study contributes to the strategic management literature. Firstly, it developed measures for two important constructs: DCs and the success trap, helping advance future research. Secondly, the study identifies two commonalities (i.e. absorptive capability and transformative capability) of DCs across firms based on quantitative findings, and further discusses firm-specific routines associated with the commonalities based on qualitative findings. This contributes to the debate on commonalities and specificities of DCs. Thirdly, for the first time in the literature, the study reveals that the success trap has a significant negative effect on DCs whilst market dynamism does not have a significant effect on DCs. DCs significantly affect firms' entrepreneurial capabilities (i.e. exploratory capabilities and exploitative capabilities) and consequently firm performance. Overall, the study reveals that firms' DCs and entrepreneurial capabilities contribute to differential firm performance.

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Abbreviations

EFA	Exploratory Factor Analysis
Aero	Aerospace
ANOVA	Analysis of Variance
BBC	British Broadcasting Corporation
BERR	Business, Enterprise and Regulatory Reform
BIS	Business Innovation and Skills
CBI	Confederation of British Industry
CFA	Confirmatory Factor Analysis
DC	Dynamic Capability
DCs	Dynamic Capabilities
DSP	Digital Signal Processor
DV	Dependent Variable
EMEA	European Medicines Agency
EPS	Earning Per Share
EXPLOIT	Exploitative Capabilities
EXPLOR	Exploratory Capabilities
FP	Firm Performance
IJV	International Joint Venture
IO	Industrial Organisation
IV	Independent Variable
KMO	Kaiser-Meyer-Olkin
KS	Kolmogorov-Smirnov
M&O	Medical and Optical Equipment
MAR	Missing at Random
MCAR	Missing Completely at Random
MD	Market Dynamism
NESTA	National Endowment for Science, Technology and the Arts
NMAR	Not Missing at Random
O&C	Office and Computing
OECD	Organization for Economic Development and Cooperation
P&B	Pharmaceuticals and Biotechnology

PCB	Printed Circuit Board
PhD	Doctor of Philosophy
R&D	Research and Development
RBV	Resource-Based View
ROE	Return on Equity
ROI	Return on Investment
RT&C	Radio, TV and Communication
SIC	Standard Industry Classification
SIIF	Science & Innovation Investment Framework
SME	Small and Medium-Sized Enterprise
SPSS	Statistical Package for the Social Sciences
ST	The Success Trap
TV	Television
UK	United Kingdom
UKIIF	UK Innovation Investment Fund
US	United States
VIF	Variance Inflation Factor
VRIN	Valuable, Rare, Imperfectly Imitable and Non-substitutable

Chapter 1: Introduction

1.1. Overview

In coping with the continuous changes in the business environment that is caused by changes in technology, competition and customer demands, firms need not only to adapt to and exploit those changes in the business environment but also to seek opportunities to create change (Helfat et al., 2007). In order to carry out such entrepreneurial activities and "to survive and prosper under conditions of change, firms must develop the 'dynamic capabilities' to create, extend, and modify the ways in which they make their living" (Helfat et al., 2007:1). However, over the past decade, there have been debates in the strategic management literature that have been mainly focused on two important issues: first, the nature of dynamic capabilities (DCs) and the definition of the concept and second, the antecedents and consequences of DCs (Easterby-Smith, Lyles and Peteraf, 2009). The debates have been mainly based on conceptual or empirical evidence that are largely derived from anecdotal qualitative studies. Therefore, based on the resource-based (e.g. Barney, 1991; Peteraf, 1993; Wernerfelt, 1984) and DCs literature (e.g. Teece, 2007; Teece and Pisano, 1994; Teece, Pisano and Schuen, 1997) and drawing on evidence from the United Kingdom (UK) small and medium-sized high-technology firms (UK high-tech SMEs), this study mainly examines the nature of DCs and their antecedents and consequences. In doing so, it tests the effects of internal and external factors that may affect the development and application of DCs. Moreover, the study examines the effect of DCs on entrepreneurial capabilities of firms as possible significant consequences of DCs and also how entrepreneurial capabilities of firms could lead to differential firm performance.

DCs can be formed by internal and external antecedents. The most widely debated external antecedent of DCs is the external environment of the firm (e.g. Aragon-Correa and Sharma, 2003; Kor and Mahoney, 2005; Teece, Pisano and Schuen, 1997). On the other hand, internal processes (e.g. Zahra, Sapienza and Davidson, 2006), learning (e.g. Zollo and Winter, 2002), managers (e.g. Adner and Helfat, 2003; Eisenhardt and Martin, 2000; Helfat et al., 2007; Narayanan, Colwell and Douglas, 2009), research and development (R&D) investment (e.g. Kor and Mahoney, 2005) have been discussed as possible internal antecedents of DCs. Among a wide range of possible influential

factors, this study focuses on the internal factor "the success trap" that is associated with learning and the external factor "market dynamism".

DCs arise from learning (Teece, Pisano and Schuen, 1997; Zollo and Winter, 2002) and learning has its own traps (Levinthal and March, 1993) that can be of two types: (1) "the success trap" that may lead to excessive exploitation of existing capabilities of firms at the cost of exploration of new capabilities required for long-term sustainability and (2) "the failure trap" that may lead to excessive exploration of new capabilities negating short-term commercial benefits (Levinthal and March, 1993). The success trap may have stronger impact on firm performance than the failure trap does (Lee and Van den Steen, 2010). Thus, this study examines the effect of the success trap on DCs as an internal antecedent.

As far as the external factors are concerned, this study focuses on the role of market dynamism in the development and use of DCs of firms. Particularly motivated by the debate on the relationship between the two constructs in the extant literature (e.g. Eisenhardt and Martin, 2000; March, 1991; Zahra, Sapienza and Davidson, 2006), the study investigates the effect of market dynamism on DCs as an external antecedent.

Furthermore, in identifying the consequences of DCs, the study examines the effect of DCs on entrepreneurial capabilities. In doing so, the effect of DCs on firm's exploratory capabilities that are concerned with discovery of opportunities and exploitative capabilities that are used in exploitation of those opportunities (Alvarez and Busenitz, 2001; Shane and Venkataraman, 2000) is examined. More importantly, the study addresses the central question in strategic management, i.e. why firms achieve differential performance. Even though some scholars propose a direct link between DCs and firm performance (e.g. Teece, Pisano and Schuen, 1997; Zahra, Sapienza and Davidson, 2006; Zollo and Winter, 2002), some others have challenged such direct link between the two constructs (e.g. Eisenhardt and Martin, 2000; Zott, 2003). As argued by Eisenhardt and Martin (2000) and Zott (2003), not DCs themselves but the resource configurations created by DCs can influence firm performance. Thus, in this study, it is argued that the entrepreneurial capabilities that are influenced by DCs (Zahra, Sapienza and Davidson, 2006) can affect firm performance. Therefore, the study also examines the effect of the above entrepreneurial capabilities (i.e. exploratory capabilities and exploitative capabilities) on firm performance of high-tech SMEs. Considering the fact that exploratory capabilities and exploitative capabilities may have fundamentally

different influences on firm performance (March, 1991; He and Wong, 2004), the effects of the two types of entrepreneurial capabilities on firm performance are tested separately.

The possession of DCs is especially relevant to firms operating in environments that are characterised by rapid technological change; particularly firms in high-technology sectors, the firm success depends on their ability to discover and develop opportunities (Teece, 2007). Therefore, such technological change requires firms to exploit existing capabilities for short-term commercial benefits and simultaneously explore new capabilities for long-term success (Gibson and Birkinshaw, 2004). Thus, considering the role of high-technology sectors in the UK economy and also responding to the calls for conceptual and empirical advancement of DCs in small and medium sized enterprises (SMEs) (Sapienza et al., 2006; Zahra, Sapienza and Davidson, 2006), the study draws evidence from a sample of UK high-tech SMEs.

Furthermore, the research hypotheses are derived from the conceptual and empirical work found in the extant literature. The study adopts a two-stage research design where the quantitative survey method is employed as the main method and semi-structured interviews are conducted as a complementary method. The rest of this chapter presents the rationale of the study, research objectives, intended contributions and the structure of the thesis.

1.2. Rationale of the Study

1.2.1. Theoretical Background

The overarching theory of this study is the resource-based view (RBV) (Barney, 1991; Peteraf, 1993; Wernerfelt, 1984) within the strategic management literature. Extending the RBV theory, Teece, Pisano and Schuen (1997) introduced the DCs perspective with the intention of explaining how firms can be the winners in the competitive market. Therefore, Zahra, Sapienza and Davidson (2006) suggest that some firms being able to seek new capabilities and exercise existing capabilities better than others depends on their ability to develop and apply different DCs. However, as mentioned earlier, the nature of DCs and their antecedents and consequences have remained under-researched. Thus, addressing this research gap and drawing on data from the UK high-tech SMEs, this study examines the nature of DCs focusing on their components, and the effects of

the success trap and market dynamism on DCs, and the influence of DCs on the entrepreneurial capabilities of firms and in turn on firm performance.

The central question in strategic management is why firms achieve differential firm performance. The strategic management theories that explain the key to firm performance have been swinging between two main approaches (Hoskisson et al., 1999): (a) the inside-out approach that argues that a firm's continued success chiefly depends on its internal and unique competitive resources (Barnard, 1938; Penrose, 1959; Selznick, 1957) and (b) outside-in approach that believes that firm's success depends on the structure of the industry it operates in and how it positions itself in business competition (Bain, 1956 and 1968; Mason, 1939; Porter, 1980 and 1985). Hoskisson et al. (1999) further claim that the development of the resource-based view (RBV) mainly by Barney (1991) and Wernerfelt (1984), has moved the field of strategic management towards the inside-out approach that is focused on firms' internal strengths and weaknesses. Emergence of the RBV revolutionised the strategic management research (Zajac, 1995). For example, as pointed out by Mahony and Pandian (1992), the RBV stimulates dialogue between scholars from key research areas of strategic management, first, by incorporating traditional strategy insights concerning heterogeneous firm capabilities, second, by providing valuable theoretical propositions within the diversification strategy literature, and third, by complementing the industrial organisation research. The DCs perspective has extended the RBV by adding a dynamic dimension to the theory and it addresses some of the criticisms against the RBV (e.g. Priem and Butler, 2001). The relationship between the RBV and the DCs perspective can be understood in light of the link between capabilities and resources. Amit and Schoemaker, (1993: 35) define resources as a firm's "stocks of available factors" whilst the capabilities are a firm's "capacity to deploy resources". Makadok (2001) who attempted to synthesise the RBV and the DCs perspective, claims that the former is associated with "resource-picking" whereas the latter is connected to "capability-building". Furthermore, Mahony and Pandian (1992) maintain that DCs are created over time and may depend on the history of the use of resources.

Therefore, considering the above connection between resources and capabilities of firms and based on the inside-out approach of strategic management, this study adopts the RBV and the DCs perspective as its main theoretical underpinnings. Following Shane and Venkataraman (2000) and Alvarez and Busenitz (2001), the study measures the entrepreneurial capabilities of firms focussing on their exploratory capabilities and

exploitative capabilities (March, 1991). Thus, the research problem investigated in this study can be summarised as follows:

> *How do high-tech SMEs develop and apply DCs and entrepreneurial capabilities to improve firm performance?*

1.2.2. Methodological Justification

This study takes the firm as the unit of analysis to address the above research problem (Covin and Slevin, 1991; Davidsson and Wiklund, 2001). There is a call for RBV research to use multiplicity of methods to study firm resources (Hoskisson et al., 1999). For example, in their study of European and American pharmaceutical industries, Henderson and Cockburn (1994) used quantitative questionnaires and qualitative interviews. Therefore, bringing the strengths of both quantitative and qualitative methods together and avoiding the limitations of relying on either quantitative or qualitative methods alone, the study adopted a two stage research design: in stage one, the study employed the survey method, which is the main method, and in stage two, the study used semi-structured interviews as a complementary method. In order to understand the commonalities of DCs and the relationship between possible antecedents and consequences of DCs, a mail survey was conducted among an effective sample of 113 UK high-tech SMEs across five high-tech industries. The survey was complemented by the semi-structured interviews with 20 senior executives of 20 high-tech SMEs, one representing each firm, who also participated in the survey. The research hypotheses derived from the theoretical model developed based on conceptual and empirical evidence in the literature that were statistically tested using survey data and those results along with other quantitative findings, were further explored using qualitative data.

In understanding the nature, antecedents and consequences of DCs, acknowledging firm resources as the key to sustainable competitive advantage (Penrose, 1959), the study operationalises the DCs construct that is associated with a firm's ability to integrate, build, and reconfigure resources (Eisenhardt and Martin, 2000; Teece, Pisano and Schuen, 1997) along the key components. Those components were identified in light of conceptual and empirical evidence found in the extant literature (e.g. Pandza and Holt, 2007; Wang and Ahmed, 2007). Furthermore, the success trap construct is operationalised based on Levinthal and March's (1993) conceptualisation and Ahuja

and Lampert's (2001) clarification of the key essence of the success trap, i.e. how firms can be trapped by familiarity, maturity and propinquity. Where possible, for constructs such as market dynamism (e.g. Atuahene-Gima, 2005), exploratory capabilities and exploitative capabilities (e.g. Atuahene-Gima, 2005), firm performance (e.g. Baum, Calabrese and Silverman, 2000; He and Wong, 2004; Lumpkin and Des, 2006; Morris et al., 2006; Robson and Bennett, 2000; Wu et al., 2006) existing measures are used in this study.

1.2.3. Practical Justification

The Organization for Economic Development and Cooperation (OECD) defines industries that report more than 4% R&D intensity and that are also knowledge-intensive as high-tech industries (Smith, 2000). This study adopts the European Commission's (2005) criteria of SMEs where firms with 10 to less than 50 employees are defined as small firms and those with 50 to less than 250 employees are identified as medium-sized firms. Furthermore, the study is conducted in the context of UK high-tech SMEs that have been described as the "firms with advanced knowledge and capabilities in technology, an educated workforce, and the ability to adapt quickly to fast changing environments" (Crick and Spence, 2005:168).

The SMEs provide nearly 60% of the jobs and 50% of GDP of the UK (Department for Business Innovation and Skills - BIS, 2010a). The SME Risk Index of global insurer Zurich (2012), reports that UK SMEs are concerned about their future; 11% have considered closing down as a possible impact of the current economic downturn. The index further reports that SMEs are starting to fight back by reviewing their business models and looking for new opportunities through business innovation, cost and expense reduction, exploring web-trading and online marketing, targeting new customers, and diversifying their business offering.

There is more evidence that shows the importance of high-tech industries in the UK economy. High-tech industries accounted for over 30% of exports in the UK in 2003 (OECD, 2005). The importance of those industries is further evident in UK government's initiatives such as giving a £75 million boost for high-tech SMEs (Fergusson, 2011). The Confederation of British Industry (CBI) predicts that high-tech exports could give a £20 billion boost to the UK economy by 2020 and, particularly, SMEs have the most growth potential in achieving this target (CBI, 2011). The CBI

(2011) report also points out the need for exploring and exploiting new opportunities. However, the difficulty in developing DCs is one of the main reasons for the lack of innovation in European firms (Delmas, 2002) and this could be relevant to UK firms as well. Therefore, among other things, this study examines the level of DCs and their effect on entrepreneurial capabilities of UK high-tech SMEs.

1.3. Research Objectives

Based on the above theoretical underpinnings and addressing the above research problem, this study aims to achieve the following objectives in the context of UK high-tech SMEs:

(1) To understand how firms develop and apply DCs: (a) testing the effect of the success trap on the development and application of DCs of high-tech SMEs, and (b) testing the effect of market dynamism on the development and application of firms' DCs,

(2) To examine the nature of DCs and their effect on entrepreneurial capabilities, i.e. exploratory capabilities and exploitative capabilities, and to test the relationship between exploratory capabilities and exploitative capabilities, and

(3) To establish the effects of entrepreneurial capabilities on firm performance.

1.4. Intended Contribution

The intended contribution of the study can be presented under three areas: theoretical, methodological and practical contributions.

1.4.1. Theoretical Contribution

This study makes a significant theoretical contribution to the strategic management literature in general, and DCs and entrepreneurial capabilities literatures in particular.

First, the study investigates and provides empirical evidence for the presence of commonalities of DCs across firms as suggested by Eisenhardt and Martin (2000). In light of empirical evidence, the study redefines the components of DCs (Garud and Nayyar, 1994; Pandza and Holt, 2007; Wang and Ahmed, 2007) those manifest the commonalities of DCs. Then it goes on to identify the specific routines within those commonalities of DCs using qualitative findings.

Second, the study examines and then explains, as an internal factor, how the success trap can influence the development and application of DCs of firms. The danger of learning traps, the success trap and competence traps (Ahuja and Lampert, 2001; March, 1991; Levinthal and March, 1993) have been discussed in prior research. However, no systematic evidence exists to gauge the effect of the success trap on capability development. This study is the first to examine the direct effect of the success trap on the development and application of DCs.

Third, the study extends the knowledge of the role of market dynamism (Eisenhardt and Martin, 2000; March, 1991; Zahra, Sapienza and Davidson, 2006) as a potential external antecedent of DCs of firms. The related findings would be particularly important as the role of the environmental dynamism or market dynamism has been central to the debate on Teece, Pisano and Schuen's (1997) original definition of DCs.

Fourth, the study contributes to the understanding of entrepreneurial capabilities of firms by empirically testing the effect of DCs on constructs of exploratory capabilities and exploitative capabilities as entrepreneurial capabilities (Alvarez and Busenitz, 2001; Shane and Venkataraman, 2000) and by explaining how firms could achieve differential performance depending on the level of their DCs and entrepreneurial capabilities.

1.4.2. Methodological Contribution

Methodologically the study contributes to the strategic management literature by developing measures for two important constructs: DCs and the success trap. Prior research on DCs and the success trap is largely conceptual, and empirical work is piecemeal in nature due to the lack of effective measures. Going beyond anecdotal evidence of DCs and the success trap research, the new measures may be adopted by future researchers to measure firm-level DCs and the success trap to increase the comparability and generalisability of research findings. The study develops measures for DCs by adapting existing measures in the literature (Gibson and Birkinshaw, 2004; García-Morales, Llorens-Montes and Verdu –Jover, 2008; Hughes and Morgan, 2007; Wang and Ahmed, 2004). The study also develops original measures for the success trap construct based on Levinthal and March's (1993) interpretation and Ahuja and Lampert's (2001) clarification of the key essence of the success trap.

1.4.3. Practical Contribution

First, identifying the nature and the effect of the success trap in the context of high-tech SMEs would help managers avoid such traps.

Second, the study provides implications for managerial practice in dealing with the market environment of high-tech industries and how the firms can stay ahead of the competition.

Third, understanding commonalities of DCs across firms and how firms can develop unique, firm specific DCs within those commonalities is important for managers of firms in gaining and sustaining the competitive advantage.

Firms' ability to continuously create, define, discover and exploit entrepreneurial opportunities may depend on its ability to develop and apply different DCs (Zahra, Sapienza and Davidson, 2006). Therefore, firms need DCs to reconfigure their resource base (Eisenhardt and Martin, 2000) to develop entrepreneurial capabilities to identify and pursue new opportunities. Thus, fourth, this study also makes a practical contribution by providing implications for managers of firms in understanding the level of significance of the effects of DCs on each type of entrepreneurial capability and how firms can be ambidextrous by maintaining a balance between the two types of capabilities.

1.5. Structure of the Thesis

The thesis has eight chapters:

Chapter 1 gives an introduction to the study.

Chapter 2 reviews the relevant literatures where it gives an overview of the main approaches of strategic management including a discussion on the resource-based view, the overarching theory of the study, followed by a review of the DCs perspective.

Chapter 3, from the lens of the resource-based view and the DCs perspective, develops the research model of the study indicating the possible relationships among the

constructs and formulates hypotheses based on evidence from conceptual and empirical work reported in the literature review.
Chapter 4 introduces the research methodology of the study. The chapter first introduces the research philosophy, the research approach, the research setting, the research design, quantitative data collection and analysis, and qualitative data collection and analysis. The ensuing sections cover triangulation, common method variance and preliminary results and data screening.

Chapter 5 analyses the quantitative data drawn from the mail survey, which is the main method of the study, and reports the findings. The chapter starts with a preliminary exploratory analysis of data and moves on and subject the data on the key constructs to exploratory factor analysis. Then, the chapter presents the results of hypotheses testing.

Chapter 6 reports the findings of the analysis of the qualitative data collected through semi-structured interviews, a complementary method to the main mail survey. First, the chapter identifies the sources and mechanisms of developing DCs. Then it moves on to explain the relationship between the success trap and DCs and also the relationship between market dynamism and DCs of firms. Next, the chapter explains the relationship between DCs and entrepreneurial capabilities. The subsequent section deals with the relationship between entrepreneurial capabilities and firm performance.

Chapter 7 discusses the findings of the quantitative data analysis supported with those of the qualitative data analysis. The discussion is organised focusing on individual hypothesis that were statistically tested in Chapter 5 and were further explained using the qualitative findings in Chapter 6.

Chapter 8 draws the conclusion of the study from the discussion of the findings of the analysis of empirical data. The chapter first summarises the main findings of the study and then presents its theoretical implications. This is followed by the methodological implications and managerial implications of the study. The limitations of the study are acknowledged and finally, the directions for future research are presented.

Chapter 2: Literature Review

2.1. Introduction

This study is broadly positioned within the strategic management literature. Based on the RBV and the DCs perspective, it particularly focuses on how DCs and entrepreneurial capabilities can lead to differential firm performance. This chapter is organised under two broad sections: an overview of the main approaches of strategic management and the DCs perspective.

2.2. An Overview of the Main Approaches of Strategic Management

From a capabilities perspective, this study addresses the problem why firms achieve differential firm performance, which has been central to the strategic management discourse, in the context of high-tech SMEs. The study mainly focuses on how firms' DCs can affect their entrepreneurial capabilities and how those capabilities can influence their performance. To pursue this research objective, first, it is important to understand the concept and different approaches of strategic management.

The term strategy emanates from the Greek verb *stratego* which means, in warfare, to 'plan the destruction of one's enemies through effective use of resources' (Bracker, 1980:219). Similar to warfare, in a business context, strategy is necessary to face the change in the environment that can be caused by two significant factors: (1) the marked acceleration in the rate of change within firms, and (2) the accelerated application of science and technology to the process of management (Ansoff, 1969). Based on an analysis of major writers' definitions from 1947-1977, Bracker (1980) claims that business strategy is characterised by environmental or situational analysis and utilisation of resources to attain a firm's major goals.

Bracker (1980:221) defines strategic management as "the direct organizational application of the concepts of business strategy that have been developed in the academic realm. That is, strategic management entails the analysis of internal and external environments of a firm to maximise the utilization of *resources* in relation to

objectives". The role of senior managers who take major initiatives on behalf of the owners of firms is central in strategic management (Nag, Hambrick and Chen, 2007).

The past two decades reports a significant growth in strategic management as a field (Teece, 2009) taking different approaches. Mintzberg, Ahlstrand and Lampel (1998) identify ten different schools of thought in strategic management that view strategy formation process from different perspectives and they broadly classify those schools into three categories: (1) *prescriptive* (a process of conception; a formal process; an analytical process); (2) *descriptive* (a visionary process; a mental process; an emergent process; a process of negotiation; a collective process; or a reactive process); and (3) *configurational* (a process of transforming the organisation). Providing a comprehensive analysis of different approaches of strategic management, Hoskisson et al. (1999:418) claim that "...strategic management has traditionally focussed on business concepts that affect firm performance" and describe the theoretical and methodological evolution of the field using the metaphor of 'swings of a pendulum' where the approaches have been moving between focusing on inside the firm and on outside the firm. In the early development of the field of strategic management, the emphasis was on *internal competitive resources* (*inside-out*) (Barnard, 1938; Penrose, 1959; Selznick, 1957) and in the 1970s the field moved toward *industry structure and competitive position* (*outside-in*) (Bain, 1956 and 1968; Mason, 1939; Porter, 1980 and 1985) influenced by industrial organisation economics; in the mid-1970s the field of strategic management moved back toward the firm and specially transaction costs economics (Williamson, 1975 and 1985) and agency theory (Fama, 1980; Jenson and Meckling, 1976) that largely contributed to strategic management. During this time the focus was on both *firm* and *the environment* (*in between inside-outside*); however, with the development of the RBV (Barney, 1991; Wernerfelt, 1984), the field of strategic management has returned to *inside-out* approach with an emphasis on firms' *internal strengths and weaknesses*. Even though, the adoption of 'scientific' methods using large data samples developed strategic management into a more respected field, the RBV requires multiplicity of methods that include both quantitative and qualitative methods, to study firm resources (Hoskisson et al., 1999). The two main approaches, i.e. outside-in and inside-out are briefly discussed next.

2.2.1. The Outside-In Approach

Taking an outside-in approach, the focus of the field of strategic management started moving toward industrial organisation (IO) economics in 1970s. The outside-in approach has its roots in the work by scholars like Bain (1956, 1968) and Mason (1939). Mason (1939) discusses the price responses of firms to changes in the economy whereas Bain (1956) points out the effect of barriers to entry on competition. Furthermore, based on IO economics but moving away from industry level to group level, the concept of strategic groups was developed (Hunt, 1972 in Hoskisson et al., 1999) where firms are grouped into different categories based on their strategies and their behaviour is determined by the category (Porter, 1981). In addition, research on competitive dynamics (Bernheim and Whinston, 1990; Edwards, 1955) that moved further away from industry level research to firm level, emerged drawing on IO economics (Hoskisson et al., 1999).

The Bain/Mason IO paradigm took industry as the unit of analysis and adopted a static perspective (Porter, 1981). Taking a static perspective, the Bain/Mason paradigm was aimed at explaining industry performance resulted from a given industry structure but it does not explain "what made structure what it was, and what did one do about changes in structure from a strategic standpoint?" (Porter,1981:613). However, overcoming those limitations, IO was further developed during 1970s (Porter, 1981).

Making a significant contribution to the outside-in approach of strategic management, building upon IO scholars and focusing on the industry structure, Porter (1980) presents his generic strategies for gaining and sustaining competitive advantage. Porter (1980) also advocates the importance of applying structural analysis of industries in formulating competitive strategies. He further advances the approach by presenting principles of competitive advantage with a focus on the value chain (Porter, 1985).

The outside-in theories have been criticised for their theoretical and methodological limitations. Barney and Hoskisson (1990) challenge the 'strategic groups' theory pointing out the lack of theoretical support for the concept of strategy groups, and also showing that a firm's performance may not depend on strategic group membership. Despite being the most influential scholar in the school of outside-in theorists, Porter's work has been criticised in the literature. For example, Pfeffer (1994) studied five leading American companies and compared them with Porter's (1985) strategic

positioning framework and concluded that none of the companies adopted the framework.

As described by Hoskisson et al. (1999), since mid 1970, the approach to strategic management started moving more toward the firm that can be identified as an inside-outside approach.

2.2.2. Inside-Outside Approach

Transaction cost economics (Williamson, 1975 and 1985) and agency theory (Fama, 1980; Jenson and Meckling, 1976) are the most influential theories of the inside-outside approach of strategic management (Hoskisson et al., 1999). Transaction cost economics has its roots in Coase's (1937) work on transaction costs. As described by Hoskisson et al. (1999), transaction cost economics takes firm-level dyadic transactions as the unit of analysis where the efficient outcome is minimisation of transaction costs. In other words, the main focus of transaction cost economics is transaction cost economising (Williamson, 1975).

On the other hand, agency theory is concerned with the principal–agent relationship between the owners and managers of modern corporations where the unit of analysis is the contract (Hoskisson et al., 1999). According to Jenson and Meckling (1976), such agency relationships involve delegating some decision making authority to the agent where the agent perform some service on behalf of the principal. Fama (1980) argues that separation of ownership and control can be an efficient form of economic organisation from a 'set of contracts' perspective.

However, Donaldson (1990) criticises transaction cost theory and agency theory for giving a negative view of managers depicting them as tending to act in opportunistic, self-serving, guileful and lazy ways at the cost to their employers. Donaldson (1990) further argues that these theories lack concepts for acknowledging a positive view of managerial motives and behaviour. Criticising opportunities that plays key role in Williamson's (1985) transaction cost economics, Hill (1990:511) concludes that the "invisible hand of the market favours actors whose behavioural repertoires are biased toward cooperation, rather than opportunism". Those criticisms finally moved the focus of strategic management research back toward the starting point of the firm's *internal competitive resources* (*inside-out*) (Barnard, 1938; Penrose, 1959; Selznick, 1957). The

inside-out approach in the present context has been mainly represented by the resource based view of the firm (Wernerfelt, 1984) that clearly addresses the fundamental question of "why firms are different and how firms achieve and sustain competitive advantage" (Hoskisson et al., 1999: 437). Furthermore, in late 1990s the DCs perspective (Teece, Pisano and Schuen, 1997) was introduced extending the RBV.

2.2.3. The Inside-Out Approach: The Resource-Based View of the Firm

The focus of strategic management research moved back toward the starting point of the firm's internal competitive resources (inside-out) (Barnard, 1938; Penrose, 1959; Selznick, 1957). As described by Hoskisson et al. (1999), early work in this approach were based on seminal work by Barnard (1938), Selznick (1957) and Penrose (1959) who were interested in the inner growth engines of the firm. However, the RBV (Wernerfelt, 1984) which has its roots in the work by Penrose (1959), marked the return of strategic management research to the inside-out approach in early 1980s. In her seminal book '*Theory of the Growth of the Firm'*, Penrose (1959) views a firm as a collection of resources: a firm is more than an administrative unit and it is also a collection of productive resources, the disposal of which between different uses and over time is determined by administrative decision. Thus, the size of a private business firm can be measured by the productive resources it employs (Penrose, 1959).

Therefore, in understanding the RBV, first, it is necessary to understand what RBV theorists viewed as *resources*. Wernerfelt (1984:172) claims that "a firm's resources at a given time could be defined as those (tangible and intangible) assets which are tied semi permanently to the firm". Daft (1983) maintains that resources include all assets, capabilities, organisational processes, firm attributes, information, knowledge etc that a firm controls that enable the firm to formulate and implement strategies to improve its efficiency and effectiveness. Barney (1991) classifies firm resources into three categories namely physical capital, human capital and organisational capital resources. He further claims that those attributes of a firm's physical, human and organisational capital resources which contribute to conceiving and implementing strategies that result in high efficiency and effectiveness in firms are considered as resources in the RBV model (Barney, 1991). In other words, only those capital resources that contribute to firm strategy are treated as resources under the RBV model. On the other hand, Eisenhardt and Schoonhoven (1996:137) describe resources as "strengths or assets of the firm that may be tangible (e.g. financial assets, technology) or intangible (e.g.

reputation and managerial skills)". Thus, resources of a firm include both physical and human resources and they are both important. According to Godfrey and Gregersen (1999), resources are defined as those assets, skills, knowledge, etc that create and sustain competitive advantage; however, not all the assets of a firm are resources; only those assets that lead to economic rents are resources. This resonates Penrose's (1959) original view that *resources* are not the inputs in the production process, but only the *services* that the resources can render (Penrose, 1959); claiming that it does not make a distinction between resources and services, Penrose (1959) intentionally avoids using the term 'factors of production'

Accordingly, in the context of the RBV, those tangible or intangible (Eisenhardt and Schoonhoven, 1996) that contribute to a firm's competitive advantage (Barney, 1991) can be considered as resources. This idea has been stressed in almost all the above views in one way or the other (e.g. Daft, 1983; Godfrey and Gregersen, 1999; Penrose, 1959). Among all the above views, Daft's (1983) view gives a better idea in understanding resources as it includes both tangible and intangible resources and tries to distinguish between those which contribute to a firm's competitive advantage (in terms of contribution to strategy) and those do not. More importantly, Daft's (1983) definition of resources includes capabilities and knowledge as well.

Following Penrose (1959), the RBV of the firm was first conceptualised by Wernerfelt (1984) in an attempt to look at firms in terms of their resources rather than in terms of their products. Wernerfelt (1984) develops a few economic tools to analyse a firm's resource position and to look at some strategic options. For example, Wernerfelt (1984) examines resource position barriers where he applies the concept of first mover advantage to resources where he argues that someone who already holds a resource can adversely affect the cost or revenues of later acquirers. In addition, analogous to growth-share matrix (Boston Consulting Group, 1972), Wernerfelt (1984) develops a resource-product matrix that, as described by Hoskisson et al. (1999), examines the balance between the exploitation of existing resources and the development of new ones. Building upon Penrose (1959), Rumelt (1984) and Wernerfelt (1984 and 1989), Barney (1991) develops a comprehensive framework that defines the characteristics of firm resources required to gain and sustain competitive advantage. As described by Barney (1991), the RBV is concerned with gaining competitive advantage through effective use of resources and innovations:

> A firm is said to have *competitive advantage* when it is implementing a value creating strategy not simultaneously being implemented by any current or potential competitors. A firm is said to have a *sustained competitive advantage* when it is implementing a value creating strategy not simultaneously being implemented by any current or potential competitors and when these other firms are unable to duplicate the benefits of this strategy. (Barney, 1991:102)

Barney (1991) challenges the assumptions of Porter's (1980) environmental models of competitive advantage pointing out that those assumptions eliminate firm resource heterogeneity and immobility as possible sources of competitive advantage. Specially, Porter's (1980) model does not explain why some firms are able to gain competitive advantage in the market whilst others are unable to gain and some others are unable to sustain what they gained. The RBV addresses this weakness by pointing out that difference in firm resources leads to differences among firms in gaining and sustaining competitive advantage (Black and Boal, 1994). The resource-based model is based on two alternate assumptions in analysing sources of competitive advantage (Barney,1991:101): (1) "Firms within an industry (or group) may be heterogeneous with respect to the strategic resources they control" and (2) "These resources may not be perfectly mobile across firms, and thus heterogeneity can be long lasting". Barney (1991) further claims that the resource-based model examines the implications of these two assumptions for the sustained competitive advantage (Figure 2.1).

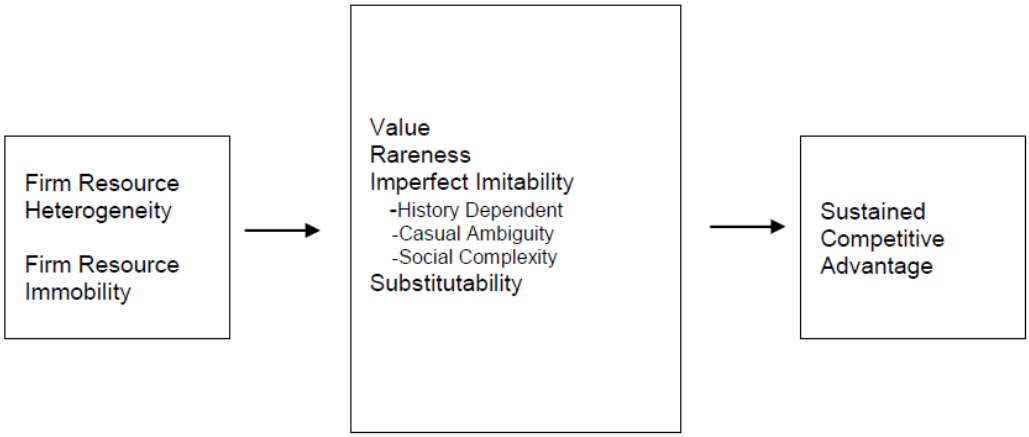


Figure 2.1.The Resource-Based Model of Competitive Advantage
(Source: Barney, 1991:112)

In his model, Barney (1991) suggests the kind of empirical questions that need to be addressed in order to understand whether or not a particular firm resource is a source of sustained competitive advantage: is that resource valuable?, is it rare?, is it imperfectly imitable? and are there substitutes for that resource? In other words, firms with *valuable*, *rare*, *imperfectly imitable* and *non-substitutable* (VRIN) resources are able to gain sustainable competitive advantage over others in the industry. Although the RBV theorists discuss about bundles of resources, the above VRIN framework treats resources as 'singular distinct items' (Black and Boal, 1994:132). Among the VRIN characteristics of resources above, Hoopes, Madsen and Walker (2003) argue that only *value* and *inimitability* (isolated from imitation or substitution) are important and the *rareness* matters only if those resources are valuable and inimitable. Strengthening the inside-out view of competitive advantage of firms, Rumelt's (1991) empirical findings reveal that it is business unit specific effects such as resources or market positions that determine business performance, rather than external factors like corporate resources or membership in an industry.

Grant (1996a) proposes a knowledge-based theory of firm, an extension to the RBV, which perceives the primary role of the firm as integrating the specialist knowledge resident in individuals into goods and services. He claims that the primary task of management is to establish the coordination necessary for this knowledge integration (Grant, 1996b). Spender (1996) also supports a knowledge-based theory claiming that a knowledge-based theory of the firm can yield insights beyond the production-function and resource-based theories of the firm. Knowledge-based theory is a platform for a new view of the firm as a dynamic, evolving and quasi-autonomous system of knowledge production and application. In order to build a knowledge-based theory of the firm, it is necessary to go well beyond the concepts of knowledge which the positivist training offers (Spender, 1996).

Knowledge can be seen as a rare, valuable, imperfectly imitable and non-substitutable strategic asset suggested by the RBV (Halawi, Aronson and McCarthy, 2005).Thus, among other things, knowledge is also a part of strategic resources of a firm. Halawi, Aronson and McCarthy (2005) claim that knowledge has the potential to be a source of

competitive advantage for an organisation. They propose a research model incorporating three types of environment: the organisational environment which includes all the internal variables; task environment which includes the external variables with immediate relevance and direct interactions with the organisation; the general environment which includes the external variable with potential relevance and no direct interaction with the organisation. The model has several important constructs, namely the knowledge management infrastructure, the knowledge quality, the knowledge management system and sustainable competitive advantage (Halawi, Aronson and McCarthy, 2005). This study takes both internal and external environments of firms into consideration.

However, the RBV has been criticised in the literature and the main critiques are centred around the following points: *causal ambiguity* (Godfrey and Gregersen, 1999; Priem and Butler, 2001), *tautology* (Eisenhardt and Martin, 2000; Priem and Butler, 2001) and *heterogeneity* (Foss, 1998; Godfrey and Gregersen, 1999; Lazonick, 2002 and 2004).

Priem and Butler (2001) conclude that the RBV has not yet reached the level of a theory mainly as a result of its assumption that product market is stable and failure to explain how resources' values are determined. Particularly, it has been argued that the elemental strategy concept of ‘value’ which is a critical factor for entrepreneurial success remains outside the RBV (Priem and Butler, 2001). As far as the criticism of causality is concerned, Godfrey and Gregersen (1999) describe the RBV as a causal theory that links idiosyncratic firm resources and competitive advantages or economic rents: the RBV predicts a causal relationship between firm resources and competitive advantage. By nature, a causal theory wants one to believe in that relationship in the first place. In the case of the RBV, this causal relationship is ambiguous. As mentioned earlier, Penrose (1959) has clearly mentioned that it is not resources but the services rendered by them that matter when it comes to economic rents. This view of Penrose (1959) also questions the validity of causality presented in the RBV.

The problem of tautology in the RBV (Eisenhardt and Martin, 2000) also undermines its validity as a theory. Identifying VRIN resources based on superior firm performance and attributing such performance to unique resources create this tautology (Eisenhardt and Martin, 2000). On the other hand, as noted by Mahoney and Pandian (1992),

possession of VRIN resources would not guarantee rents for a firm, it is a firm's unique competence in making effective use of its resources that brings rents to a firm. Based on his analysis of published empirical research on the RBV, Newbert (2007) concludes that, not just resources, firms looking for sustained competitive advantage need to possess and exploit valuable, rare and inimitable/non-substitutable resources, capabilities and core competencies. However, Mahoney and Pandian (1992) acknowledge that, even though it is not comprehensive, the RBV provides an illuminating generalisable theory of growth of the firm.

The RBV has also been criticised for its assumption of heterogeneity of resources claiming that it is not convincing. In high-tech industries, which are characterised by rapid change (Godfrey and Gregersen, 1999), the assumption of heterogeneity would not hold. Thus, firms will not be able to sustain their competitive advantage with same set of 'heterogeneous' resources. Therefore, firms adopt various strategies to acquire, or according to Godfrey and Gregersen (1999), to generate new resources. However, as pointed out by Foss (1998), the most profound problem with the RBV is lack of theorising with respect to the creation of new resources which gives the view a retrospective character and makes its application in managerial practice difficult. The RBV does not explain how some firms rather than others accumulate valuable and inimitable resources or what make these resources valuable and inimitable (Lazonick, 2002 and 2004). In other words, the RBV is not clear about what helps firms acquire or generate new resources which their competitors do not possess. Therefore, to overcome this problem, Foss (1998) suggests that resource-based scholars could relate their work to research on areas such as innovations and organisational learning.

Strategic factor market logic has been identified as a RBV/capability perspective. According to Leiblein (2011), this concept assumes that firms access resources/factors of production available in those markets, and strategic factor market logic has been used to understand competition over the bidding and application of resources (e.g. Adegbesan, 2009; Barney, 1986; Makadok, 2001; Makadok and Barney, 2001; Maritan and Florence, 2008; Peteraf, 1993). Three mechanisms through which superior performance can be achieved have been identified in the factor market literature (Leiblein, 2011): (1) luck (e.g. Barney, 1986; Denrell, Fang, and Winter, 2003; Lippman and Rumelt, 1982; Makadok and Barney, 2001) which means even if all competitors have similar information, a fortunate few may generate superior returns;

(2) superior information which means that better informed firms may generate competitive advantage by making fewer errors than their less informed competitors (e.g. Barney, 1986; Makadok, 2001); and (3) heterogeneity in productive resources which means that competitive advantage largely depends on a firm's ability to assemble uniquely complementary sets of resources (e.g. Lippman and Rumelt, 2003; Milgrom and Roberts, 1990; Montgomery and Wernerfelt, 1988).

The above review reveals that the RBV has been the dominant theory in strategic management over the last three decades. Peteraf (1993:179) endorses the RBV as a model claiming that the theory is 'unique to the field of strategic management' in understanding how firms compete. Extending and strengthening the RBV, the dynamic capabilities perspective (Teece, 2007; Teece and Pisano, 1994; Teece, Pisano and Schuen, 1997:516) was introduced in mid 1990s.

2.3. The Dynamic Capabilities Perspective

In order to meet the need for an expanded paradigm to understand how, particularly in the context of highly competitive high-tech industries, firms gain and sustain competitive advantage, the dynamic capabilities perspective (Teece and Pisano, 1994) was developed in early 1990s. Introducing the DCs perspective, Teece and Pisano (1994) explain that as prescribed in the RBV, accumulating valuable technology assets would not be enough to gain a significant competitive advantage. The "winners in the global marketplace have been firms that can demonstrate timely responsiveness and rapid and flexible product innovation, coupled with the management capability to effectively coordinate and redeploy internal and external competences" (Teece and Pisano, 1994:538). Thus, firms need DCs to gain and sustain the competitive advantage. In contrast to the RBV, the emphasis of DCs perspective is on 'dynamics' (Easterby-Smith, Lyles and Peteraf, 2009). However, it should be noted here that the DCs perspective has been built upon similar assumptions to the RBV (Ambrosini and Bowman, 2009). Furthermore, not only the RBV but also the DCs perspective has its roots in Penrose's (1959) work (Augier and Teece, 2008). Teece and Pisano (1994) claim that DCs perspective has links to the Schumpeterian (1934) as well.

2.3.1. The Concept of Dynamic Capabilities

DCs enable firms to renew their resources in responding to changes in their environment (Ambrosini and Bowman, 2009). Furthermore, as defined by Helfat et al.

(2007: 4), a DC is "the capacity of an organization to purposefully create, extend, or modify its resource base". Therefore, in understanding the concept of DCs, first, it is necessary to distinguish between resources and capabilities. Amit and Schoemaker (1993:35) define the firm's *resources* as "the stocks of available factors that are owned or controlled by the firm" and firm's *capabilities* as "a firm's capacity to deploy *resources,* usually in combination, using organizational processes, to effect a desired end". Resources mainly include knowhow, financial or physical assets, human capital etc. (Amit and Schoemaker, 1993). According to Teece and Pisano (1994: 538), capabilities are associated with "appropriately adapting, integrating, and re-configuring internal and external organizational skills, resources, and functional competences toward changing environment" which is a central role in strategic management. This interpretation is complemented by Makadok (2001) who views capability as a non-transferable firm specific resource and that improves the productivity of other resources of the firm. Thus, it is quite clear that capabilities are also included in firm's resources and, unlike other resources, they may be non-transferable and may also be unique to a firm.

The term *dynamic* represents the shifting nature of the environment (Teece and Pisano, 1994) and DCs refer to "the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments" (Teece, Pisano and Schuen, 1997:516). In line with Teece, Pisano and Schuen (1997:516), Eisenhardt and Martin (2000) who describe DCs as organisational and strategic routines or processes which help firms achieve new resource configurations as markets change, also acknowledge the effect of the dynamic environment on DCs. Eisenhardt and Martin (2000) have made three observations in their review of DCs. First, as mentioned above, DCs consist of specific strategic and organisational processes that create value for firms within dynamic markets by manipulating resources into new value-creating strategies. Thus, DCs are neither vague nor tautological; second, these capabilities exhibit commonalities across effective firms (best practices); third, effective patterns of DCs depend on market dynamism (The relationship between market dynamism and DCs is discussed in Chapter 3). While claiming that DCs are "not simply processes, but are embedded in processes", Wang and Ahmed (2007:35) also link DCs to the changing environment.

However, Teece, Pisano and Schuen's (1997) definition has been criticised for not being clear about where DCs come from and also for restricting DCs to dynamic environments (Ambrosini and Bowman, 2009; Zollo and Winter, 2002). Therefore, Zollo and Winter (2002:340) define a DC as "a learned and stable pattern of collective activity through which the organization systematically generates and modifies its operating routines in pursuit of improved effectiveness" despite the nature of the environment. Furthermore, DCs operate through repeated recombination of stable organisational factors rather than disrupting them (Salvato, 2003). More importantly, DCs arise from learning which includes experience accumulation, knowledge articulation and knowledge codification (Zollo and Winter, 2002). The operating routines that were traditionally thought to develop through experience accumulation and knowledge articulation, involve collective discussions, debriefing sessions and performance evaluation processes, whereas knowledge codification deals with individuals codifying understanding of the performance implications of the routines (Zollo and Winter, 2002). Such routines include the forms, rules, procedures, conventions, strategies technologies, beliefs, frameworks, paradigms, codes, cultures and knowledge of a firm (Levitt and March, 1988).

Schreyogg and Kliesch-eberl (2007:919) identify three approaches of dynamising DCs: the radical dynamisation approach (i.e. "dynamic capabilities as a functional equivalent to classical capabilities in dynamic environments"), the integrative approach (i.e. "amending capabilities by adding a dynamic dimension"), and the innovation routine approach (i.e. "task of dynamisation to a special type of routine called innovation routine"). Eisenhardt and Martin (2000), Teece, Pisano and Schuen (1997) and Zollo and Winter (2002) are examples for the three types respectively (Schreyogg and Kliesch-eberl, 2007). According to Schreyogg and Kliesch-eberl (2007), the radical dynamisation approach is a contingency approach of capabilities dynamisation depending on the market dynamism (Eisenhardt and Martin, 2000): in moderately dynamic markets firms need 'DCs' whereas in high-velocity markets firms need 'radical DCs'. As discussed in Schreyogg and Kliesch-eberl's (2007) integrative approach, DCs are the mechanism of adapting, integrating, and reconfiguring resources and capabilities to meet the demands of a changing environment (Teece, Pisano and Schuen, 1997). Furthermore, the innovation routines approach views DCs as a collective activity of generating innovation (high-order) routines by modifying its operating (low-order) routines (Zollo and Winter, 2002).

Eisenhardt and Martin (2000) argue that in moderately dynamic markets, routines in the form of DCs are embedded in existing knowledge whereas in high velocity markets DCs rely on new knowledge created for specific situations. More importantly, DCs exhibit commonalities across firms and therefore, they demonstrate a greater equifinality, homogeneity and substitutability across firms than traditional RBV thinking (Eisenhardt and Martin, 2000). Equifinality denotes the availability of multiple paths to the same DC (Eisenhardt and Martin, 2000). For example, Cockburn, Henderson and Stern (2000) report that, in the pharmaceutical industry, in offering propublication incentives to scientists, managers showed different starting points and took different paths, but eventually most firms adopted propublication incentives for their scientists which can be identified as a common practice in creating new knowledge in the pharmaceutical industry. In addition, Rothaermel and Hess (2007) conclude that in searching for new knowledge, firms used different internal (e.g. generating knowledge through research efforts by their own scientists) or external (e.g. gaining knowledge from external sources) knowledge sources which demonstrate some level of equifinality in firms practices in developing DCs. As far as substitutability is concerned, effective DCs can differ in details whilst having important commonalities (Eisenhardt and Martin, 2000). For example, as pointed out by Eisenhardt and Martin (2000), Cockburn, Henderson and Stern's (2000) study suggest that the DCs associated with the knowledge creation processes are substitutable. Furthermore, commonalities of DCs imply their fungibility across different contexts (Eisenhardt and Martin, 2000). Resources have certain degree of fungibility (Penrose, 1959; Teece, 1982) and this explains the fungibility of DCs as they represent firms' ability to reconfigure its resources.

The review of extant literature reveals some interesting tensions regarding the DCs. Ambrosini and Bowman (2009) identify DCs as processes which influence firm resources whereas, as mentioned above, Wang and Ahmed (2007) identify DCs as not just processes but as a capacity embedded in processes because processes can be imitated by competitors and if they can be imitated, they are not DCs. However, following Eisenhardt and Martin (2000), Wang and Ahmed (2007) also claim that DCs can be idiosyncratic in their details, but, as mentioned above, they can also have commonalities of DCs across firms.

Another question in defining DCs is whether DCs are a response to dynamic environments or not. For example, Aragon-Correa and Sharma (2003), Kor and Mahoney (2005), Teece, Pisano and Schuen (1997) and Wang and Ahmed (2007) maintain that DCs address rapidly changing environments. However, arguing against the above view, Zollo and Winter (2002) claim that DCs should not be restricted to dynamic environments and DCs are a learned and stable pattern of collective activity in pursuit of high effectiveness whether they are operating in dynamic environments or not.

In addition, the relationship between resources and DCs has been another debatable area. Eisenhardt and Martin (2000) argue that DCs lead to new resource configurations. Definitions by Ambrosini and Bowman (2009) and Wang and Ahmed (2007) also agree with this argument. In contrast, in their model, Zahra, Sapienza and Davidson (2006) assume that, even though it is indirect, resources have an impact on DCs of a firm. Reconciling this conflict, Cepeda and Vera's (2007) empirical study reveal that the input of DCs is an initial configuration of resources and operational routines whereas the output of DCs is a new configuration of resources and operational routines. Thus, it seems that firm resources and DCs influence each other.

As discussed above, whether DCs should be defined linking them to firm performance or not is another interesting argument found in the literature. For example, Ambrosini and Bowman (2009), Eisenhardt and Martin (2000), Zahra, Sapienza and Davidson (2006) and Williamson (1999) criticise attributing DCs to superior firm performance, claiming that such approach would make the concept tautological. However, Williamson (1999) admits that even the concept of transaction costs suffered from a tautological reputation when it was introduced in the late 1930s and it took thirty five years to operationalise the concept in the early 1970s. Particularly, Zahra, Sapienza and Davidson (2006) suggest that DCs should be identified independent of firm performance and having DCs does not guarantee successful outcomes or *vice versa*. Wang and Ahmed (2007) also propose an indirect relationship between DCs and firm performance. Huang et al. (2012) identify three dimensions of DCs i.e. process, position and path. It was empirically established that the process and position of DCs have direct positive impacts on the competitive advantage of firms that was measured using firm's market performance as indicated by their sales. Excluding firm performance, this study adopts Teece, Pisano and Schuen's (1997) definition of DCs to avoid tautology in

defining DCs. Teece, Pisano and Schuen's (1997) definition of DCs has been acknowledged for being broad enough for others to refine, reinterpret and expand the concept (e.g. Easterby-Smith, Lyles and Peteraf, 2009). Table 2.1 presents selected research on DCs.

Table 2.1. Selected Research on Dynamic Capabilities*

Author/s and the Year	Type/ Approach	Definition	Sample Studied	Key Findings/Contributions
Teece and Pisano (1994)	Conceptual	The subset of the competences/capabilities which allow the firm to create new products and processes, and respond to changing market circumstances (1994:541).	N/A	Introduced the concept of DCs.
Camuffo and Volpato (1996)**	Empirical: Qualitative	No original definition.	Fiat Auto	Implementation of automation techniques and the development of related knowledge are of cumulative nature and path-dependent.
Teece, Pisano and Schuen (1997)	Conceptual	The firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments (1997:516).	N/A	Developed a DCs framework suggesting that wealth creation by private enterprises in rapidly changing environments largely depends on internal technological, organisational and managerial processes and not on strategising as suggested by outside-in (product-market based) frameworks of sustainable competitive advantage.
Helfat (1997)**	Empirical: Quantitative	No original definition.	26 firms in the US energy industry	R&D capabilities declined due to falling oil prices and complementary technological knowledge or benefits of exploitation of complementary coal assets could not stop it.
Tripsas (1997)**	Empirical: Qualitative	No original definition.	Mergenthaler Linotype comparing to two other firms	Development of external integrative capability and utilisation of multiple R&D locations helped develop DCs of Mergenthaler Linotype.
Oktemgil and Greenlay (1997)	Empirical: Quantitative	No original definition.	2000 managing directors of the machine-tools industry, UK	Identified two levels of adaptive capabilities which are associated with different levels of performance; the two levels of adaptive capabilities have different external environments and their internal environments feature different response factors.
Petroni (1998)**	Empirical: Qualitative	No original definition.	Smith and Nephew	New product development capabilities are mainly based on project management techniques and research-oriented and result-oriented culture of an organization.
Majumdar (1999)**	Empirical: Quantitative	No original definition.	39 local operating companies of large firms in the US telecommunication industry	Size of firms does not affect their ability to change in a dynamic setting. The inertia argument is not valid.
Deeds, DeCarolis and Coombs (1999)**	Empirical: Quantitative	No original definition.	94 pharmaceutical biotechnology companies	New product development is a function of a firm's location, scientific capabilities, external contacts, and the functional and educational background of top managers.
Delmas (1999)**	Empirical: Quantitative	No original definition.	927 cases of technological acquisitions by firms in the waste management industry in Europe and North America	Firms will rely on alliances for tacit technologies in highly uncertain environments, despite high transaction costs considering the flexibility and adaptability in such collaborations to build competencies and to gain competitive advantage.

Forrant and Flynn (1999)**	Empirical: Qualitative	No original definition.	Brimfield Precision, USA	A firm can develop DCs through continuous improvement relying on its employees.
Pisano (2000)**	Empirical: Qualitative	No original definition.	Longitudinal case studies of four biotechnology firms	Potential outputs of every development project are twofold: a process technology used in manufacturing and a technical knowledge of underlying cause-and-effect relationships.
Esenhardt and Martin (2000)	Conceptual	The firm's processes that use resources-specifically the processes to integrate, reconfigure, gain and release resources-to match and even create market change. Dynamic capabilities thus are the organizational and strategic routines by which firms achieve new resource configurations as markets emerge, collide, split, evolve, and die (2000:1107).	N/A	Argued that DCs are a set of specific and identifiable processes and they are neither vague nor tautological. DCs are idiosyncratic and path dependent in their emergence, they have significant commonalities across firms.
Lehrer (2000)**	Empirical: Qualitative	No original definition.	British Airway, Lufthansa and Air France.	Firms can choose between evolutionary and revolutionary approaches in managing capabilities to gain competitive advantage.
Madhok and Osegowitsch (2000)**	Empirical: Quantitative	No original definition.	Cross-border transactions of biotechnology firms between US and Europe (1981-1992)	Found that the DCs perspective and technology accumulation perspective can be used to understand the organisational form and flow of technology in the international biotechnology industry.
Makadok (2001)	Conceptual	A special type of resource-specifically, an organizationally embedded non-transferable firm-specific resource whose purpose is to improve the productivity of the *other* resources possessed by the firm (2001:389).	N/A	Synthesized the RBV and DCs with regard to rent creation. Developed a model predicting that the two rent-creation mechanisms are complementary in some circumstances but substitutes in others.
Griffith and Harvey (2001)**	Empirical: Quantitative	No original definition.	Overseas SME distributors of US manufacturers: 250 Canadian, 250 Chilean, 100 Great Britain, 100 Filipino and 147 Greek firms	Global DCs of a firm depend on firms power derived from internal (Resource-based) and external (Market-based) assets.
Spanos and Lioukas (2001)**	Empirical: Quantitative	No original definition.	187 Greek firms in various manufacturing industries	Together with strategic activities, effects of both industry and firm assets contribute to firm success.
Noda and Collis(2001)**	Empirical: Qualitative	No original definition.	7 regional holding companies of Bell in the US cellular telephone service industry	Proposed process framework for understanding the evolution of intraindustry firm heterogeneity.
Rindova and Kotha (2001)**	Empirical: Qualitative	No original definition.	Yahoo and Exite	Introduced the concept of 'continuous morphing' for renewing competitive advantage.

Zahra and George(2002)	Conceptual	No original definition.	N/A	Developed a model distinguishing a firm's potential and realised absorptive capacities.
Zollo and Winter (2002)	Conceptual	A dynamic capability is a learned and stable pattern of collective activity through which the organization systematically generates and modifies its operating routines in pursuit of improved effectiveness (2002:340).	N/A	Argued that DCs are shaped by coevolution of learning mechanisms in firms.
King and Tucci (2002)	Empirical: Quantitative	No original definition.	208 business units representing 174 distinct organizations in the disk-drive industry (1976 - 1995)	Experience in previous markets increases the probability that a firm would enter a new market; this experience has greater value if the firm entered the new market.
D'Este (2002)**	Empirical: Quantitative	No original definition.	67 Spanish domestic pharmaceutical firms (1990 – 1997)	High performing firms were the ones which generated capabilities unique to them.
Winter (2003)	Conceptual	An organizational capability is a high-level routine (or collection of routines) that, together with its implementing input flows, confers upon an organization's management a set of decision options for producing significant outputs of a particular type (2003:991).	N/A	Classified capabilities into 'zero-order' capabilities and 'higher-order' capabilities.
Adner and Helfat (2003)	Empirical: Quantitative	Dynamic managerial capabilities are the capabilities with which managers build, integrate, and reconfigure organizational resources and competences. The concept of dynamic managerial capabilities is a direct analogy to more general organizational 'dynamic capabilities' (2003:1012).	30 companies in the US petroleum industry (for a 21 year period)	The concept of dynamic managerial capabilities would help understand the difference in managerial response to change in the external environment.
Lampel and Shamsie (2003)**	Empirical: Quantitative	Industry capabilities are systemic properties that result from the behaviour of firms acting to improve their position within this ecology by searching for new practices and routines. Industry capabilities emerge because search behaviour is recursive: firms not only search for new routines and practices to manage their own internally held resources, they also develop routines and practices to identify and adapt their competitors' routines and practices (2003:2206).	400 films split between the studio and post-studio eras in the Hollywood movie industry	Evolution of DCs is influenced by changes in the relationship between firm and the industry structure.
Figueiredo (2003)**	Empirical: Qualitative	No original definition.	CSN and USIMINAS in the Brazil steel industry	The way intra-firm learning processes and mechanisms are managed over time influences the inter-firm capability accumulation and competitive performance.

Meyer and Lieb-Doczy (2003)**	Empirical: Qualitative	No original definition.	18 longitudinal case studies in East Germany and Hungary	Post-acquisition restructuring is an evolutionary process; acquirers providing autonomy and complementary resources to the subsidiary can get more contribution from the acquired assets in the long-run.
Salvato (2003)**	Empirical: Qualitative	No original definition.	Case studies of two Italian firms: Alessi and Modafil	Strategic evolution is a result of recombinations of a firm's strategy with new resources and organisational routines; DCs of a firm operate through repeated recombination of stable organizational factors rather than disrupting them.
Verona and Ravasi (2003)**	Empirical: Qualitative	No original definition.	Oticon A/S	Identified three DCs: knowledge creation and absorption, knowledge integration, and knowledge reconfiguration as the driving forces of continuous innovation.
Alvarez and Merino (2003)**	Empirical: Quantitative	No original definition.	Spanish savings and loans institutions	Environment evolution drives organisational renewal which is complex, because different adaptation mechanisms, strongly influenced by organisational resources and capabilities, converge.
Zott (2003)	Empirical: Quantitative (Simulated data)	No original definition.	N/A	Timing, cost, and learning effects foster the emergence of significant performance differences among firms with strikingly similar DCs. Even small initial differences among firms can generate significant intraindustry differential firm performance, particularly when the effects of timing, cost and learning are combined.
Macpherson, Jones and Zhang (2004)	Empirical: Qualitative	Dynamic capabilities' refers to the ability of managers to create innovative responses to a changing business environment (2004:2004).	A UK high-tech firm (RWL)	Successful innovation is based on managerial capabilities that already existed within the firm; those internal capabilities can be enhanced and extended through relationships within the supply chain.
Keli (2004)**	Empirical: Qualitative	No original definition.	2 longitudinal case studies in European ICT sector	Capability building occurs through adopting learning strategies within and outside the venturing relationships. Those learning processes are influenced by initial resource endowments and initial organisational structure.
Roy and Roy (2004)**	Empirical: Qualitative	No original definition.	HP and Compaq merger	Relevant DC in integrating was sub-optimal in the HP-Compaq merger, and the ability of leadership may have been crucial.
Sako (2004)**	Empirical: Qualitative	No original definition.	3 Japanese automakers: Honda, Nissan and Toyota	The three companies enhanced organisational capabilities of suppliers through (1) enabling companies to share the practice of tacit knowledge, (2) broadening the scope of supplier development through interdependence in the hierarchy of routines, and (3) thereby challenging suppliers to accept customer companies' intervention in decision making.
Brady and Davis (2004)**	Empirical: Qualitative	No original definition.	Ericsson and Cable & Wireless (C&W)	A project capability building model consisting of two levels of learning: bottom-up exploratory learning and top-down exploitative learning.

Mota and Castro (2004)**	Empirical: Qualitative	No original definition.	Two firms in the Portuguese moulds industry: Tecmolde and Iberomoldes	A firm's vertical boundaries reflect their relationships with specific counterparts and the way they address the division and integration of knowledge through configurations of direct and indirect capabilities.
Athreye (2005)**	Empirical: Qualitative	No original definition.	The Indian software industry	Tight labour market conditions play an important role in developing process capability of firms and entrepreneurial experimentation plays a key role in evolving a business model (outsourced software) particularly in a context of limited resource advantage.
Woiceshyn and Daellenbach (2005)**	Empirical: Qualitative	No original definition.	4 firms in the Canadian oil and gas industry	Some firms are better than others in adopting new technology because the efficacious firms have strong strategic commitment and facilitate more extensive external and internal integration than less efficacious firms. They also differ in terms of knowledge systems, i.e. employee skills, technical and managerial systems, and values and norms.
George (2005)**	Empirical: Quantitative	No original definition.	Historical data on patenting and licensing activities at Wisconsin Alumni Research Foundation	There is a curvilinear relationship between experiential learning within a capability and the costs of developing that capability.
Newbert (2005)**	Empirical: Quantitative	No original definition.	817 adult, American nascent entrepreneurs, defined as individuals 18 years or older	A common set of gestation activities exists for successful nascent entrepreneurs, market dynamism affects the complexity and characteristics of the new firm formation process, and learning negatively impacts new firm formation success for nascent entrepreneurs operating in highly dynamic markets.
Lazonick and Prencipe (2005)**	Empirical: Qualitative	No original definition.	Rolls-Royce, UK	Strategic control and financial commitment are necessary but not sufficient conditions of innovative enterprise as innovation depends on organisational learning and organisational learning depends on organisational integration.
Zahra, Sapienza and Davidson (2006)	Conceptual	The abilities to reconfigure a firm's resources and routines in the manner envisioned and deemed appropriate by its principal decision-maker(s) (2006:918).	N/A	Defined the construct DCs, separated DCs from substantive capabilities (SCs).
Arthurs and Busenitz (2006)	Empirical: Quantitative	No original definition.	268 venture capitalist-backed and non- venture capitalist-backed new ventures	Venture capitalists act as a catalyst in bringing about DCs in product and management development.
Wu (2006)	Empirical: Quantitative	Dynamic capability is the firm's ability to integrate, learn and reconfigure resources; its ability to transform the existing resource base and to internalize external resources in order to be effective in a rapidly evolving environment (2006:448).	244 Taiwanese IT firms	In unstable environment, resources influence performance through exercising DCs.

Teece (2007)	Conceptual	For analytical purposes, dynamic capabilities can be disaggregated into the capacity (1) to sense and shape opportunities and threats, (2) to seize opportunities, and (3) to maintain competitiveness through enhancing, combining, protecting, and, when necessary, reconfiguring the business enterprise's intangible and tangible assets. Dynamic capabilities include difficult-to-replicate enterprise capabilities required to adapt to changing customer and technological opportunities. They also embrace the enterprise's capacity to shape the ecosystem it occupies, develop new products and processes, and design and implement viable business models (2007:1319-1320).	N/A	Identified the micro foundations of DCs.
Wang and Ahmed (2007)		…a firm's behavioural orientation constantly to integrate, reconfigure, renew and recreate its resources and capabilities and, most importantly, upgrade and reconstruct its core capabilities in response to the changing environment to attain and sustain competitive advantage (Wang and Ahmed, 2007:35).	N/A	Presented a new hierarchy of capabilities clarifying confusions in previous typologies in the literature, and identified three component factors of DCs.
Wu (2007)	Empirical: Quantitative	No original definition.	200 Taiwanese start-up high-tech firms	DCs significantly help to leverage entrepreneurial resources to benefit start-up performance, and DCs mediate between entrepreneurial resources and performance.
Pablo et al.(2007)	Empirical: Qualitative	No original definition.	Calgory Health Region-CHR, Canada	An organisation can use a DC (learning through experimenting) as a strategic approach to pursue continual organisational improvement.
Harreld, O'Reilly and Tushman (2007)	Empirical: Qualitative	…the firm's ability to leverage and reconfigure its existing competencies and assets in ways that are valuable to the customer but difficult for competitors to imitate (2007:24).	IBM	Developing DCs is a fundamental and enduring task of executive leadership. Firms often get trapped by their own success; the only way out of this trap is for senior leaders to help their firms develop the DCs that promote sustained competitive advantage.
Silva and Leitão (2007)	Empirical: Quantitative	No original definition.	The data obtained through the 2nd Community Innovation Survey (CIS II) by EUROSTAT among 819 firms in Portuguese	Identification of stimulating factors and restraining factors of the entrepreneurial innovative capability of Portuguese industrial firms.

Augier and Teece (2008)	Conceptual	'Dynamic capabilities' refers to the particular (non-imitable) capacity business enterprises possess to shape, reshape, configure, and reconfigure assets so as to respond to changing technologies and markets and escape the zero profit condition (2008:1190).	N/A	Suggested an 'evolution with design' where enterprise was seen as a product of both evolutionary process and intentional design.
O'Reilly and Tushman (2008)	Conceptual	No original definition.	N/A	Suggested how ambidexterity acts as a DC.
Dacko et al.(2008)	Conceptual	No original definition.	N/A	Focused on rhythm matching (firm readiness rhythm and market receptivity rhythm) in NPD and proposed a new typology.
Ambrosini and Bowman (2009)	Conceptual	Dynamic capabilities are processes that alter that [a firm's] resource base (2009:35).	N/A	Identified a set of internal and external enablers and inhibitors of DCs; identified processes that create DCs; explained that DCs do not automatically lead to performance improvements.
Ambrosini, Bowman and Collier (2009)	Conceptual	No original definition.	N/A	Suggest three levels of DCs that are identified in relation to perceived environmental states: (1) "incremental" DCs" those capabilities effect incremental changes to the resource base and those DCs are associated with stable environments; (2) "renewing" DCs, those capabilities that refresh and renew the nature of the resources base and those DCs are connected to dynamic environments; and (3) "regenerative" DCs which change, not only the firm's resource base, but also its current set of DCs and those DCs are applicable in hyper environments.
Ellonen, Wikström and Jantunen (2009)	Empirical: Qualitative	Dynamic capabilities, in turn, could be seen as higher-order organizational capabilities that make it possible to learn about new domains, create new asset combinations and build new capabilities in order to match market (perceptible and latent) needs (2009: 755).	Four cases from the Scandinavian publishing industry	The firms with relatively strong DCs in all three areas of sensing, seizing and reconfiguring seem to produce revolutionary innovations that combine their existing capabilities either market or technology dimension with new capabilities whereas those with weaker DCs tend to produce more radical innovations that require both market and technological capabilities.
Danneels (2010)	Empirical: Qualitative	Dynamic capability refers to the ability of a firm to renew itself in the face of a changing environment by changing its set of resources (2010:2).	The manufacturer of typewriters Smith Corona	Provided insights into the resource alteration processes by which DC operates and highlighted resource cognition as a missing element in DC theory.
Barreto (2010)	Conceptual	A dynamic capability is the firm's potential to systematically solve problems, formed by its propensity to sense opportunities and threats, to make timely and market-oriented decisions, and to change its resource base (2010:271).	N/A	Reviewed the diverse research streams on DCs, identified main limitations and challenges, and suggested a new conceptualisation of DC.

Katkalo, Pitelis and Teece (2010)	Conceptual	The firm's capacities to integrate, build, and reconfigure internal and external resources/competences to address and shape rapidly changing business environments (2010:1177-1178).	N/A	Activities conducted to create and capture value were organised by clusters of DCs, i.e. Sensing, Seizing Transforming.
Salvato and Rerup (2010)	Conceptual	Dynamic capabilities are higher-level routines for adapting operational routines and capabilities to dynamic environment. They evolve through explicit managerial intervention (2010: 471).	N/A	Proposed some foundations for a multilevel perspective for studying the microfoundation of routines and capabilities.
Di Stefano, Peteraf and Verona (2010)	Empirical: Quantitative(co-citation analysis)	No original definition.	371 articles dealing with DCs published prior to 2008 in any of the business and management journals.	Revealed the field of DCs invisible colleges and research directions. Found evidence of commonalities as well as differences among understandings across the DCs research domain.
Wu (2010)	Empirical: Quantitative	No original definition.	253 Taiwanese firms	The explanatory power of DCs view exceeds that of RBV in volatile environments.
Drnevich and Kriauciunas (2011)	Empirical: quantitative	Those capabilities used to extend, modify, change, and/or create ordinary capabilities (2011:255)	48 Chilean firms that contained multilevel data	Identified the conditions under which ordinary and dynamic capabilities contribute to higher relative firm performance.
Helfat and Winter (2011)	Conceptual	A dynamic capability is one that enables a firm to alter how it currently makes its living (2011: 1244).	N/A	Argued that the line between dynamic and operational capabilities is unavoidably blurry.
Hodgkinson and Healey (2011)	Conceptual	No original definition.	N/A	Demonstrated the psychological foundations of DCs.
Pavlou and El Sawy (2011)	Empirical: Quantitative	Those capabilities that help units extend, modify, and reconfigure their existing operational capabilities into new ones that better match the changing environment (2011: 242).	180 new product development (NPD) units from 180 distinct firms.	A set of DCs were identified and articulated, and proposed a measurable model to represent the nature of DCs. Empirically supported a structural model in which DCs have an indirect positive effect on performance by reconfiguring operational capabilities in NPD.
Protogerou, Caloghirou and Lioukas (2011)	Empirical: Quantitative	The capacity of an organization to purposefully and systematically create, extend or modify its operational capabilities (2011: 618).	271 Greek firms belonging to the manufacturing sector	Defined three components of DCs (coordination, learning, and competitive response capabilities) and concluded that DCs indirectly influence firm performance that is mediated by operational capabilities (marketing and technological capabilities).
Argote and Ren (2012)	Conceptual	No original definition.	N/A	Presented transactive memory as a microfoundation of DCs.

Barrales-Molina, Bustinza and Gutiérrez- Gutiérrez (2012)	Empirical: Quantitative	No original definition.	200 CEOs of Spanish firms from different industry Sectors	Only firms whose managers perceive a high degree of environmental dynamism generate DCs. Knowledge codification and technical innovation are significantly related to DCs.
Biedenbach and Müller (2012)	Empirical: qualitative–quantitative	No original definition.	18 interviews and 80 online surveys in European pharmaceutical and biotechnology R&D organisations.	Absorptive and adaptive capabilities are the primary contributors to the performance outcome, whereas innovative capabilities are a minor contributor project and portfolio performances in pharmaceutical and biotechnology R&D organizations.
Huang et al. (2012)	Empirical: qualitative–quantitative	No original definition.	165 Taiwanese ICT firms	Three dimensions of DCs were identified: process; position; and path. The process and position of DCs found to have direct positive impacts on competitive advantage while the position of DCs mediates the relationship between the process of DCs and firm competitive advantage. The hypothesised relationship between the path and position was not significant.
Jantunen, Ellonen and Johansson (2012)	Empirical: qualitative	Dynamic capabilities are the higher-order capabilities needed for changing operational practices and resource base of the firm and learning in new domains (2012:142).	4 case firms in the Scandinavian magazine-publishing industry	The practices comprising sensing capabilities tend to be similar across firms within a single industry; practices comprising seizing and reconfiguring capabilities are likely to be different more between companies. Therefore, DCs have both idiosyncratic as well as common features across an industry.

NOTE: *The table presents selected research on DCs where relevant work has been cited in the text. **Research cited in Wang and Ahmed (2007)

2.3.2. Capability Hierarchies and Dynamic Capabilities

The above definitions and clarifications throw a light in understanding the notion of DCs. The attempts by scholars to classify capabilities in hierarchical order further refine the DCs phenomenon.

Collis (1994) identifies four categories of organisational capabilities:(1) functional capabilities, (2) capabilities in dynamic improvements, (3) capabilities in dynamic improvements related to 'the more metaphysical strategic insights' in recognising 'the intrinsic value of other resources or to develop novel strategies before competitors' and (4) meta capabilities. Collis (1994:145) describes a meta capability as a "capability to innovate the innovation that innovates the innovation that innovates…and so on" which generates a cycle of innovation. Collis (1994) argues that organisational capabilities which include DCs do not always act as a source of sustainable competitive advantage and they are not the 'ultimate' source. As it has been pointed out by Ambrosini, Bowman and Collier (2009), the second and third categories of Collis's (1994) hierarchy which are difficult to distinguish, are, according to Teece, Pisano and Schuen's (1997) definition, DCs. As far as 'meta capabilities', the fourth category in Collis's (1994) hierarchy, are concerned, they represent the DCs that renew current DCs.

Core competencies refer to "the collective learning in the organization, especially how to coordinate diverse production skills and integrate multiple streams of technologies" (Prahalad and Hamel, 1990:82). Similarly, an operational capability is "a high-level routine (or collection of routines) that, together with its implementing input flows, confers upon an organization's management a set of decision options for producing significant outputs of a particular type" (Winter, 2000: 983). Prahalad and Hamel (1990) argue that core competencies of a firm bring competitive advantage to a firm in the long run. In contrast, O'Reilly and Tushman (2008) point out that core competencies or operational capabilities give short term competitive advantages and they are not DCs that help a firm to gain long term competitive advantage. For example, Southwest Airline's core competencies give them an advantage over their competitors, but they are not DCs since they do not ensure firms ability to change in the face of a new threat (O'Reilly and Tushman, 2008). This can be further understood by Zollo and Winter's (2002:340) hypothesis of the effect of organisational learning on DCs where they classify organisational activities that can be affected by learning, into two broad categories: operating routines, i.e. "one geared towards

the operational functioning of the firm including both staff and line activities" and DCs, i.e. the modification of operating routines. Winter (2003:992) describes operating routines as ordinary or 'zero-level' capabilities, i.e. "how we earn a living now" capabilities (e.g. capabilities needed for producing and selling same product) and DCs as the capabilities that operate to extend, modify or create ordinary capabilities, i.e. capabilities that would change the product, the production process, the scale, or the customers/markets served (e.g. capabilities needed for new product development).

Zahra, Sapienza and Davidson (2006) have identified an ability to solve a problem as a substantive capability and ability to change or reconfigure substantive capabilities as a DC. However, Zahra, Sapienza and Davidson (2006) maintain that there is confusion in the literature whether DCs refer to substantive capabilities in a volatile environment or to a firm's ability to change existing substantive capabilities. Zahra, Sapienza and Davidson (2006) also reckon that identifying DCs based on successful firm performance makes it difficult to distinguish creation of a new substantive capability from transformation of an existing one. This way of identifying DCs is misleading as one might take outcomes of DCs as DCs (Zahra, Sapienza and Davidson, 2006). As presented in Zahra, Sapienza and Davidson's (2006) model, the resources influence DCs indirectly through substantive capabilities and organisational knowledge. In turn, DCs influence firm performance indirectly through substantive capabilities and organisational knowledge. However, Wu's (2006) empirical study reveals that resources directly influence DCs.

Wang and Ahmed (2007) present an elaborate hierarchy of firm resources and capabilities with reference to the competitive advantage of a firm: resources (zero-order), capabilities (first-order), core capabilities (second order) and DCs (third-order). It seems that as it moves from resources to DCs along the hierarchy (Wang and Ahmed, 2007), the adaptability and the contribution to firm's sustainable competitive advantage increases.

Building upon past research and particularly focusing on a firm's resource base and its capacity to change the resource base, Ambrosini, Bowman and Collier (2009) suggest three levels of DCs that are identified in relation to perceived environmental states: (1) "incremental" DCs, i.e. those capabilities effect incremental changes to the resource base and those DCs are associated with stable environments, (2) "renewing" DCs, i.e. those capabilities that refresh and renew the nature of the resources base and those DCs are

connected to dynamic environments and (3) "regenerative" DCs that change, not only the firm's resource base, but also its current set of DCs and those DCs are applicable in hyper environments. They also claim that the first two levels are perceived as one and the literature label them as DCs, and the concept of "regenerative" DCs is supposed to extend the existing understanding of the DCs phenomenon.

2.3.3. The Commonalities of Dynamic Capabilities across Firms

Whether DCs are idiosyncratic by nature is the next important question that needs to be addressed in understanding the concept. As mentioned earlier, Eisenhardt and Martin (2000) maintain that when VRIN resources that bring competitive advantage are identified based on superior performance and attributing such performance to unique resources the firm possesses, the RBV becomes tautological. Defining DCs in terms of their role in resource configuration, independent of firm performance, enables empirical falsification (Eisenhardt and Martin, 2000). Identifying DCs in terms of their relationship to altering resource base (acquiring and shedding resources, integrating them together, and recombining them) and independent of their effect on the firm performance help overcome the problem of tautology (Eisenhardt and Martin, 2000). They also argue that DCs can be duplicated across firms and therefore the source of competitive advantage is not DCs themselves but "the resource configurations they create" (Eisenhardt and Martin, 2000:1106).

According to Eisenhardt and Martin (2000), whilst being idiosyncratic in their details, DCs also show common characteristics related to effective processes across firms. Product development process, which is a DC, is an example to show the commonalities across firms; some of the commonalities in product development process are participation of cross-functional teams, routines to use concrete and joint experiences among team members, use of extensive external communication (Eisenhardt and Martin, 2000). However, Eisenhardt and Martin (2000) stress the point that existence of commonalities does not mean that a particular DC is exactly the same across firms. Such, commonalities across firms' DCs have several implications such as (1) equifinality, i.e. availability of multiple paths to the same DC, (2) substitutability and fungiblility across different contexts, and (3) DCs are unlikely to be sources of sustainable competitive advantage (Eisenhardt and Martin, 2000). They go on to say that even if DCs are valuable and rare, imitability is not relevant to DCs because with equifinality, managers of firms can discover

them on their own (Eisenhardt and Martin, 2000). On the other hand, DCs are substitutable as they need to have commonalities across firms even if they can be idiosyncratic in details (Eisenhardt and Martin, 2000). As Zott's (2003) simulation study revealed, even if DCs are equifinal across firms, they can have differential firm performance due to the costs of DCs and the differential timing DCs are used. Such differences in cost and timing of managerial decisions explain possible presence of idiosyncrasies of DCs and due to such idiosyncrasies, DCs of firms may serve to gain and sustain competitive advantage (Zott, 2003).

Even though DCs can be imitated by competitors, the source of competitive advantage lies in the unique resource configuration created by those DCs and not in DCs themselves (Eisenhardt and Martin, 2000). In other words, it is not the DCs but their use makes the difference. This is in agreement with Penrose's (1959) claim with regard to resources, i.e. not resources but their use matters. In contrast to Eisenhardt and Martin (2000), Augier and Teece (2008) view DCs as the 'non-imitable capacity' of a firm. However, following Teece's (2007) components of DCs, i.e. sensing, seizing and reconfiguring, and based on evidence from four cases from the publishing industry, Jantunen, Ellonen and Johansson (2012) conclude that practices related to sensing capabilities tend to be similar across firms in a single industry while practices comprising seizing and reconfiguring capabilities can differ across firms. Moreover, the commonalities are driven by the requirements of the external environment of the firms in the same industry where as idiosyncrasies are driven by history, internal organisational mindset and strategic choices (Jantunen, Ellonen and Johansson, 2012).

Further extending the view of commonalities of DCs across firms, Eisenhardt and Martin (2000) suggest three categories of DCs: 'resource integration capabilities' (e.g. superior product development skills at Toyota), 'resource reconfiguration capabilities' (e.g. managers at IDEO, a product design firm, routinely create new products by using knowledge gathered from previous design projects) and 'resource gaining and releasing capabilities' (e.g. Cisco Systems' effective acquisition process which drives superior performance). Verona and Ravasi (2003) also identify three types of DCs (knowledge creation and absorption, knowledge integration, and knowledge configuration) as the driving forces for successful product creation. They further claim that DCs rests on simultaneous presence of the processes regarding the three components (Verona and

Ravasi, 2003). However, Verona and Ravasi's (2003) findings are based on a single case study which would offer limited help in identifying commonalities of DCs across firms.

Teece (2007) disaggregates DCs into three capacities: capacity to *sense* and shape opportunities and threats, capacity to *seize* opportunities, and capacity to maintain competitiveness by *reconfiguring* a firm's tangible and intangible assets. To be successful, firms must develop and employ capabilities in all three activities-"The enterprise will need sensing, seizing, and transformational/reconfiguring capabilities to be simultaneously developed and applied for it to build and maintain competitive advantage"- and all those capabilities are not available in individual managers and they must be available in the top management and therefore, the principle executive officer should get top managers to work as a team (Teece, 2007:1341). In summary, firms need entrepreneurial management to develop and apply DCs in sensing and seizing opportunities and maintaining competitiveness through transformational/reconfiguring capabilities (Teece, 2007). However, Easterby-Smith, Lyles and Peteraf (2009:S4) claim that Teece's (2007) disaggregation of DCs into its component parts "opens up at least as many questions as it answers".

On the other hand, drawing on empirical and conceptual evidence in the literature, Wang and Ahmed (2007) propose three distinctive but complementary components of DCs: adaptive, absorptive and innovative capabilities those are discussed in the ensuing sections. Gibson and Brikinshaw (2004:209) define adaptive capability as "the capacity to reconfigure activities in the business unit quickly to meet changing demands in the task environment". Absorptive capability refers to "the ability of a firm to recognize the value of new information, assimilate it, and apply to commercial ends" (Cohen and Levinthal, 1990:128). Innovative capability is described as the "capability of introducing new products to the market, or opening up new products to the market, opening up new markets, through combining strategic orientation with innovative behaviour and process" Wang and Ahmed (2004:304).

Following Teece (2007), Ellonen, Wikström and Jantunen (2009) detected sensing, seizing, and reconfiguring capabilities in their case firms. Agreeing with Wang and Ahmed (2007), Ellonen, Wikström and Jantunen (2009) also acknowledge how there are considerable differences in the form and strength of those capabilities across the case firms. In their

study of project management capabilities as a DC, Killen, Hunt and Kleinschmidt (2008) point out the relevance of Wang and Ahmed's (2007) definition of DC as a behavioural orientation that focuses more on the learning aspects embedded in the processes. In addition, Biedenbach and Müller (2012) adopt Wang and Ahmed's (2007) components of DCs in studying the effect of each type of capability on project and portfolio performances in pharmaceutical and biotechnology R&D organisations. They also confirm that, as proposed by Wang and Ahmed (2007), the three components of DCs are complementary to each other (Biedenbach and Müller, 2012). The above sources indicate that Wang and Ahmed's (2007) conceptualisation of components of DCs offers a clear avenue for testing commonalities of DCs across firms. As pointed out by Wang and Ahmed (2007), those commonalities of DCs across firms have not been systematically identified. Thus, in light of Wang and Ahmed's (2007) conceptualisation of components of DCs, this study attempts to empirically test Eisenhardt and Martin's (2000) argument that there are commonalities of DCs across firms and also specificities of DCs in individual firms. Particularly, Wang and Ahmed (2007) emphasise the importance of identifying and measuring the commonalities that reflect the common features of DCs across firms for three reasons: first, the common features of the component factors of DCs construct and can be used by future researchers for examining the relationships of DCs and other organisational parameters; second, the common features of DCs across firms show how firms transform resource advantage to marketplace advantage at general level instead of firm level and can be used to develop a framework to identify such transformational mechanisms in general; and third, to go beyond the theoretical work on the RBV and the firm-specific empirical studies and to develop common guidance for firms through studies on the commonalities of DCs across firms. More importantly, Wang and Ahmed's (2007) DCs components of adapting, absorbing, and innovating can be effectively used in operationalising the key elements of Teece, Pisano and Schuen's (1997) conceptualisation of DCs, i.e. integrating, building, and reconfiguring internal and external competences.

Barreto (2010) who reviewed the DCs concept, also propose a multidimentional approach in operationalising the concept and this reiterates Wang and Ahmed's (2007) approach. Furthermore, recognising DCs as a propensity, Barreto (2010) identifies four dimensions of DCs based on past research: "the propensity to change the resource base", "the propensity to sense opportunities and threats", "the propensity to make timely decisions" and "the propensity to make market-oriented decisions". More importantly, Barreto (2010)

advocates measuring DCs as an aggregate multidimensional construct. More examples of adopting a multidimensional approach, particularly based on Teece (2007), in measuring approach can be found in the recent literature, e.g. three processes as core elements of the DCs concept: coordinating/integrating, learning and strategic competitive response processes (Protogerou, Caloghirou and Lioukas, 2011); sensing the environment, learning, coordinating, and integrating capabilities (Pavlou and Sawy, 2006). Thus, as mentioned earlier, considering the conceptual clarity of each component and their operationalisability, this study measured DCs along Wang and Ahmed's (2007) three components of DCs: adaptive capability, absorptive capability, and innovative capability. The three components are briefly reviewed next.

2.3.3.1. Adaptive Capability

Firms with high levels of adaptive capability exhibit DCs (Teece, Pisano and Schuen, 1997). Chakravarthy (1982:37) defines adaptive capability as "the state of adaptation that a firm aspires to" and "is predicated on the resources that it commands", i.e. human and material. Adaptability or adaptive capability is more than adaptation: adaptation ensures survival but adaptive capability, in addition to adaptation, is about optimal use of organisational both human and material resources in a firm (Chakravarthy, 1982). Furthermore, according to Chakravarthy (1982) adaptive capability represents an optimal balance between creativity (measure of human resources) and productivity (a measure of material resources). Oktemgil and Greenlay (1997) who studied adaptive capability from a marketing perspective, claim that firms operating in more turbulent environments demonstrate adaptive capability. Furthermore, Oktemgil and Greenlay (1997) also conclude that adaptive capability may vary across firms depending on Miles and Snow's (1978) strategy type: reactors-no adaptability; defenders-low adaptability; analysers-moderate adaptability; and prospectors-high adaptability. On the other hand, Staber and Sydow (2002:410-411) report that, "when learning takes place at a rate faster than the rate of change in the conditions that require dismantling old routines and creating new ones" and it indicates that those firms have adaptive capability.

Gibson and Birkinshaw (2004:209) define adaptability (adaptive capability) as "the capacity to reconfigure activities in the business unit quickly to meet changing demands in the task environment". They claim that such adaptability activities are geared toward improving long term performance. Adaptive capabilities are difficult to measure as they

are complex, causally ambiguous, widely dispersed and time-consuming to develop (Amit and Schoemaker, 1993; Barney, 1991; Prahalad and Hamel, 1990). However, Gibson and Birkinshaw (2004) measure adaptive capability of a firm by considering three characteristics of its management systems: encouraging people to challenge outmoded traditions/practices/sacred cows; being flexible enough to allow people to respond quickly to changes in markets; and ability to evolve rapidly in response to shifts in the business priorities of the firm.

Table 2.2. Selected Research on Adaptive Capability*

Author/s and the Year	Type/Approach	Definition
Chakravarthy (1982)	Conceptual	The state of adaptation that a firm aspires to is predicated on the resources that it commands, that is its adaptive ability (1982:37).
Lau (1996)	Conceptual	Strategic flexibility [adaptive capability] refers to a firm's ability to respond to uncertainties by adjusting its objectives with the support of its superior knowledge and capabilities (1996:11).
Oktemgil and Greenlay (1997)	Empirical: Quantitative (Study in the UK machine-tools industry)	The ability to identify and capitalize on emerging market opportunities (1997:445).
Staber and Sydow (2002)	Conceptual	Organizations have adaptive capability when learning takes place at a rate faster than the rate of change in the conditions that require dismantling old routines and creating new ones.
Gibson and Brikinshaw (2004)	Empirical: Quantitative (4,195 individuals in 10 multinational firms)	The capacity to reconfigure activities in the business unit quickly to meet changing demands in the task environment (2004:209).
Ireland and Web (2007)	Conceptual	Strategic flexibility [adaptive capability] is 'a skill through which the firm is able to acquire and subsequently use information to appropriately respond to change' (2007:51).
Wei and Lau (2010)	Empirical: Quantitative (600 Chinese firms)	As a type of dynamic capability, adaptive capability is concerned with the firm's quick responses to market potentials, identifying business opportunities, and competencies of effective problem-solving (2010:1491).
Zhou and Li (2010)	Empirical: Quantitative (380 firms from 20 major cities in China)	A firm's ability to reconfigure resources and coordinate processes promptly and effectively to meet rapid environmental changes (2010:225).
Chen and Wu (2011)	Empirical: Quantitative (409 Chinese firms)	A firm's ability to respond appropriately and effectively to market changes and maintain its competitive advantages in the market (2011:583).
Biedenbach and Müller (2012)	Empirical: Qualitative-quantitative (18 interviews and 80 online surveys in European pharmaceutical and biotechnology R&D organisations.	An organization's ability to identify and capitalize on emerging market opportunities (2012:625).

NOTE: * Research papers which do not provide an original definition of the concept have been excluded from the table.

It should be noted here that as pointed out by Wang and Ahmed (2007), strategic flexibility (Sanchez, 1995) and adaptive capability are parallel terms and largely overlapping

concepts. Similar to adaptive capability, strategic flexibility is also associated with a firm's ability to respond to uncertainties caused by change in the environment (Lau, 1996). Sanchez (1997: 71-72) defines strategic flexibility as "the condition of having strategic *options* that are created through the combined effects of an organization's *coordination flexibility* in acquiring and using *flexible resources*". Strategic flexibility can be a source of competitive advantage (Lau, 1996) as firms with strategic flexibility are able to acquire and subsequently use information to appropriately respond to change (Ireland and Webb, 2007).

Based on the above review, the key research on adaptive capability are summarised in Table 2.2. Considering its clarity and operationalisability with the measures developed and tested, Gibson and Brikinshaw's (2004) definition of adaptive capability is used in this study.

2.3.3.2. Absorptive Capability

Absorptive capability is another component of DCs as proposed by Wang and Ahmed (2007) that has been discussed at firm level (e.g. Cohen and Levinthal, 1990), intra-firm level (e.g. Tsai, 2001), inter-firm level (e.g. Lane and Lubatkin, 1998; Lane, Salk and Lyles, 2001) and national level (e.g. Mowery and Oxley, 1995) in the extant literature. Firm is the unit of analysis of this research and the focus is on absorptive capability at firm-level and as a component of DCs.

Cohen and Levinthal (1990:128) describe absorptive capability (absorptive capacity) as "the ability of a firm to recognise the value of new information, assimilate it, and apply to commercial ends" and absorptive capability is critical to a firm's innovative capability. Absorptive capability of a firm depends largely on a firm's level of prior related knowledge and it is influenced by research and development (R&D) of a firm (Cohen and Levinthal, 1990). It has also been pointed out that an organisation's absorptive capability will depend on the absorptive capabilities of its individual members and the development of an organisation's absorptive capability will build upon prior investment in the development of its members' individual absorptive capabilities (Cohen and Levinthal, 1990). However, Cohen and Levinthal (1990) emphasise that it is not the mere sum of capabilities of its employees. Not only individual but also organisational characteristics play a key role in determining a firm's absorptive capability (Cohen and Levinthal, 1990).

For example, an organisation's prior related knowledge is a determinant of its absorptive capability (Cohen and Levinthal, 1990). Absorptive capability consists of both assimilation and exploitation of information; in addition to exploit new knowledge, absorptive capability helps a firm predict future technological developments as well (Cohen and Levinthal, 1994). Firms with high level of absorptive capability will tend to be more proactive, exploiting opportunities in the environment, independent of current performance whereas firms with modest absorptive capability will tend to be reactive, searching for new alternatives in response to, for example, failure in terms of profitability and market share etc (Cohen and Levinthal, 1990). Acknowledging the fact that R&D enhances absorptive capability of a firm, Cohen and Levinthal (1990) point out the need for further research to understand the decision processes that determine firms' investments in absorptive capability.

Van den Bosch, Volberda and de Boer (1999) suggest that firms' absorptive capability is determined not only by the firm's prior related knowledge as suggested by Cohen and Levinthal (1990) but also by "organisation forms", i.e. functional, divisional and matrix and "combinative capacity" (combinative capability), i.e. systems, coordination and socialization. According to Van den Bosch, Volberda and de Boer (1999) there are three types of combinative capabilities: systems capabilities (use of formal systems to integrate explicit knowledge), coordination capabilities (knowledge absorption through relations between members of a group) and socialisation capabilities (producing shared ideology, identity and collectively through firm's culture). Moreover, describing the combinative capabilities, Van den Bosch, Volberda and de Boer (1999) claim that the term "combination" used by Kogut and Zander (1992) is associated with "integration" (Grant, 1996b). In that sense, combinative capabilities and integrative capabilities seem to refer to the same concept.

Woiceshyn and Daellenbach (2005) view DCs (Teece, Pisano and Schuen, 1997) as another term for "the integrative capability" of a firm. Integrative capability refers to "the capability to integrate knowledge from sources both external and internal to the firm and utilize it productively" (Woiceshyn and Daellenbach, 2005:310). In addition, Woiceshym and Daellenbach (2005) see absorptive capability as capabilities narrower than integrative capability. However, Woiceshyn and Daellenbach's (2005) integrative capability construct

does not seem to be as comprehensive as the DCs construct that, according to Wang and Ahmed (2007), include adaptive, absorptive and innovative capabilities.

In the same study above that included two longitudinal case studies of publishing firms, Van den Bosch, Volberda and de Boer (1999) identify three types of component knowledge: knowledge related to products or services, knowledge related to production process and knowledge related to markets. Van den Bosch, Volberda and de Boer (1999:552) maintain that the ability of a firm to "evaluate, assimilate, and utilise outside knowledge for commercial ends is of crucial strategic importance". It is assumed that there are three dimensions of knowledge absorption: efficiency, i.e. the cost and economies of scale perspective of knowledge absorption), scope, i.e. breadth of component knowledge absorbed, and flexibility, i.e. the extent to which a firm can access additional component knowledge and reconfigure existing knowledge (Van den Bosch, Volberda and de Boer, 1999). The efficiency dimension is supposed to be related to exploitation whereas the flexibility dimension is believed to be associated with exploration (Van den Bosch, Volberda and de Boer, 1999). They identify two types of knowledge environments namely stable knowledge environment and unstable knowledge environment, and argue that in stable environments the focus of knowledge absorption is on exploitation of existing knowledge whereas in unstable environments firms tend to focus on knowledge exploration to increase their current knowledge base (Van den Bosch, Volberda and de Boer, 1999). These observations indicate the possible effect of absorptive capability, which is supposed to be a component DCs, on entrepreneurial capabilities, i.e. exploratory capabilities and exploitative capabilities of firms.

Stock, Greis and Fischer (2001) who studied the relationship between the absorptive capability and new product development performance found an 'inverted U' relationship between the two constructs. This means that spending more resources on R&D does not necessarily lead to more advanced new products (Stock, Greis and Fischer, 2001). In contrast, Tsai (2001) found a positive impact of absorptive capability on innovations as well as firm performance. Selected work on absorptive capability are summarised in Table 2.3

Zahra and George (2002:186) define absorptive capability (absorptive capacity) as "a set of organisational routines and processes by which firms acquire, assimilate, transform, and

exploit knowledge to produce dynamic organisational capability". In the above definition, Zahra and George (2002:185) recognise absorptive capability as a DC and broadly classify the four dimensions in to two components of absorptive capability: potential capacity which involves knowledge acquisition and assimilation capabilities, and realised capacity which consists of knowledge transformation and exploitative capabilities. As observed by Zahra and George (2002), compared with realised capacity, the potential capacity has received less empirical scrutiny. Furthermore, according to the model presented by Zahra and George (2002:191-193), knowledge sources ("acquisitions, purchasing through licensing and contractual agreements, and inter-organisational relationships, including R&D consortia, alliances, and joint ventures") and knowledge complementarity ("the extent to which knowledge is related to and at the same time different from the knowledge of contacts in their information networks") and experience ("firms gain experience through exposure to, impact of, and knowledge of particular skills and capabilities") are antecedents of the absorptive capability. In addition, there are activation triggers ("events that encourage or compel a firm to respond to specific internal or external stimuli"). Zahra, Filatotchev and Wright (2009) point out that previous theoretical and empirical work on absorptive capability has viewed R&D and firms' relationships as means of gaining knowledge. Therefore, Zahra, Filatotchev and Wright (2009) argue that threshold firms can creatively offset their limitations in resources and use their directors as a means of gaining knowledge. Emphasising the role of the top management team, Zahra, Filatotchev and Wright (2009) present a matrix combining top management team accountability and top management team absorptive capability. Thus, Zahra, Filatotchev and Wright (2009) note that absorptive capability lies in the top management teams of threshold firms.

Liao, Welsch and Stoica (2003) measure absorptive capability through two dimensions: external knowledge acquisition and internal knowledge dissemination. The firms with high absorptive capability demonstrate higher responsiveness to the environmental change (Liao, Welsch and Stoica, 2003). It should be mentioned here that whilst adaptive capability deals with changing firm resources in response to environmental change, absorptive capability connects to acquiring and utilising information and knowledge to successfully cope with the environmental change. As far as antecedents of absorptive capability are concerned, it was revealed in Narasimhan, Rajiv and Dutta's (2006) study that R&D expenditure, marketing expenditure, and a firm's prior technological stock have

a strong impact on the absorptive capability of a firm. However, the absorptive capability construct needs to be empirically validated (Wang and Ahmed (2007).

Table 2.3. Selected Research on Absorptive Capability*

Author/s and the Year	Type/Approach	Definition
Cohen and Levinthal (1990)	Empirical: Quantitative (Study in the American manufacturing sector based on data from secondary sources)	The ability of a firm to recognize the value of new information, assimilate it, and apply to commercial ends (1990:128).
Van den Bosch, Volberda and de Boer (1999)	Empirical: Qualitative (Case studies of two publishing firms)	Absorptive capacity comprises evaluation, acquisition, integration, and the commercial utilisation of new outside knowledge (1999:552).
Zahra and George (2002)	Conceptual	A set of organizational routines and processes by which firms acquire, assimilate, transform, and exploit knowledge to produce dynamic organizational capability (2002:185).
Narasimhan, Rajiv and Dutta (2006)	Empirical: Quantitative (64 semiconductor and computer firms in the US)	The efficiency with which a firm absorbs, relative to what it could have absorbed given the resources it has deployed (2006:512).
Liao, Fei, and Chen (2007)	Empirical: Quantitative (170 Taiwanese firms)	The employees' ability and motivation to obtain external knowledge and the willingness to use this knowledge in the firm's innovation capability (2011:341).
Xia and Roper (2008)	Empirical:Quantitative (349 US and European biopharmaceutical Firms)	An organisational capability reflecting firms' receptivity to technological change and the ability of a firm to effectively use outside knowledge (2008: 777-7778).
Chen, Lin and Chang (2009)	Empirical: Quantitative (106 Taiwanese firms)	The ability to enable firms to effectively acquire and utilize external knowledge as well as internal one which affects their innovations (2009:153).
Lichtenthaler and Lichtenthaler (2009)	Conceptual	A firm's ability to explore external knowledge (2009:1319).
Zhou and Li (2010)	Empirical: Quantitative (380 firms from 20 major cities in China)	The ability to assimilate and utilize new knowledge acquired from external sources (2010:225).
Cepeda-Carrion, Cegarra-Navarro and Jimenez-Jimenez (2012)	Empirical: Quantitative (286 Spanish firms)	The quality which enables knowledge to be converted into new products, services or processes to support innovation (2012:110).

NOTE: *Research papers which do not provide an original definition of the concept have been excluded from the table.

Szulanski (1996) measured absorptive capability based on Cohen and Levinthal's (1990) conceptualisation. Adapting five items form Szulanski's (1996) measure, García-Morales, Lioréns-Montes and Verdú-Jover (2008) develop and test a unidimensional scale to determine absorptive capability in their study of the effect of transformational leadership on absorptive capability. This study measures absorptive capability as a dimension of component of DCs. Therefore, adopting Cohen and Levinthal's (1990) definition of

absorptive capability (absorptive capacity), this study measures the construct using scale items developed by García-Morales, Lioréns-Montes and Verdú-Jover (2008).

2.3.3.3. Innovative Capability

Innovative capability is the next component of DCs identified by Wang and Ahmed (2007). Innovation is central to the DCs perspective (Lawson and Samson, 2001). Schumepeter (1934) defines innovation as the commercial or industrial application of something new. This can be a new product or process, a new form of organisation, a new source of supply or market. Lawson and Samson (2001:384) define innovation capability (innovative capability) as "the ability to continuously transform knowledge and ideas into new products, processes and systems for the benefit of the firm and its stakeholders" and they identify seven aspects of innovative capability: vision and strategy, harnessing the competence base, organisational intelligence, creativity and idea management, organisational structure and systems, culture and climate, and the management of technology. Lawson and Samson (2001) further suggest that developing and investing in those aspects would result in sustainable innovation outcomes and also claim that innovative capability construct needs to be refined, validated, and tested using other methods such as case studies and surveys (Lawson and Samson, 2001).

According to Hagedoorn and Duysters (2002:168), innovative capability "concerns the specific expertise and competence related to the development and introduction of new processes and products". As identified by Calantone, Cavusgil and Zaho (2002), firm innovative capability can be conceptualised from two perspectives: rate of adoption of innovations by the firm, and a firm's willingness to change. This indicates a firm's commitment to be innovative. Wang and Ahmed (2004:304) define innovative capability as an organisation's "capability of introducing new products to the market, or opening up new products to the market, opening up new markets, through combining strategic orientation with innovative behaviour and process". They identify a number of indicators which could be used to measure the dimensions of innovative capability: strategic innovative orientation, behavioural, process, product and market innovativeness (Wang and Ahmed, 2004).

Subramaniam and Youndt (2005) define two types of innovative capability: incremental innovative capability and radical innovative capability. Incremental innovative capability is

defined as "the capability to generate innovations that refine and reinforce existing products and services" and radical innovative capability is defined as "the capability to generate innovations that significantly transform existing products and services" (Subramaniam and Youndt, 2005:452). Subramaniam and Youndt (2005) assess an organisation's capability to reinforce and extend its current expertise and product/service lines in measuring incremental innovative capability and an organisation's capability to make current product/service lines obsolete in measuring radical innovative capability.

Branzei and Vertinsky (2006) describe innovation capability as DCs related to innovation activities. Based on the literature (e.g. Cohen and Levinthal, 1990; Zahra and George, 2002), Branzei and Vertinsky (2006) present a typology of four groups of innovative capabilities: acquisition, assimilation, transformation and deployment. However, this typology seems to be overlapping with some of elements of absorptive capability.

Silva and João (2007) who studied the innovative capability of Portuguese industrial firms, analysed a set of five stimulating and restraining factors influencing innovative capability: 'technological capacities', 'entrepreneurial dimension', 'activity sector', 'market orientation' and 'location of the firm'. Silva and João (2007) conclude that firms with greater technological capacities are more likely to innovate. As the technological intensity level increases, the probability of the firms to innovate their product also increases; therefore, firms in high-tech sectors are more likely to innovate than those in traditional industries (Silva and João, 2007).

From an input perspective, Hughes and Morgan (2007:652) define innovativeness (innovative capability) as "a bias toward embracing and supporting creativity and experimentation, technological leadership, novelty and R&D in the development of products, services and processes". In understanding the effect of learning orientation on innovation and performance, Calantone, Cavusgil and Zaho (2002) develop a six-item scale to measure firm innovativeness among a broad spectrum of US industries. Adapting from Calantone, Cavusgil and Zaho (2002), Hughes and Morgan (2007) developed a measure for innovative capability with 7-point Likert scales that was tested and used in the context of emerging young high-technology firms in the U.K. Considering the relevance of Hughes and Morgan's (2007) study to the context of this study, their definition of innovative capability is adopted in this study. In addition, Hughes and Morgan's (2007)

and Wang and Ahmed's (2004) measures are used to assess the innovative capability of firms.

Table 2.4. Selected Research on Innovative Capability*

Author/s and the Year	Approach	Definition
Schumepeter (1934)	Conceptual	The commercial or industrial application of something new.
Miller and Friesen (1983)	Empirical: Quantitative (50 Canadian firms and 135 periods of history in 36 US business organisations)	Innovation [innovative capability] includes introductions of new products and production-service technologies, the search for novel solutions to marketing and production problems, the attempt to lead rather than to follow competitors (proactiveness), and risk-taking (1983:222).
Lawson and Samson (2001)	Empirical: Qualitative (Case study of Cisco Systems)	The ability to continuously transform knowledge and ideas into new products, processes and systems for the benefit of the firm and its stakeholders (2001:384).
Hagedoorn and Duysters (2002)	Empirical: Quantitative (135 large US, Canadian, and European companies)	Innovative capability concerns the specific expertise and competence related to the development and introduction of new processes and products (2002:168).
Wang and Ahmed (2004)	Empirical: Quantitative (231 England, Wales and Scotland)	The propensity or likelihood that an organisation produces innovative outcomes (Wang and Ahmed, 2004:303).
Subramaiam and Youndt (2005)	Empirical: Quantitative (208 US firms)	*Incremental innovative capability*-the capability to generate innovations that refine and reinforce existing products and services (2005:452). *Radical innovative capability*- the capability to generate innovations that significantly transform existing products and services (2005:452).
Hughes and Morgan (2007)	Empirical: Quantitative (211 emerging young UK high-tech firms)	Innovativeness [Innovative capability] captures a bias toward embracing and supporting creativity and experimentation, technological leadership, novelty and R&D in the development of products, services and processes (2007:652).
Liao, Fei and Chen (2007)	Empirical: Quantitative (170 Taiwanese firms)	The performance of the enterprise going through various types of innovation and achieving an overall improvement (2007:348).
Quintana-Garcia and Benavides-Velasco (2008)	Empirical: Quantitative (A longitudinal study of a sample of US biotechnology firms)	Exploratory innovative competence [innovative capability] represents the ability to perform extensive searches that result in novel methods or materials technologically distant from existing innovations (2008:498). Exploitation [exploitative innovative capability] improves methods or materials (2008:498).
Chen (2009)	Empirical: Quantitative (122 new ventures in Taiwanese high-tech industries)	Firm's capabilities, grounded in the processes, systems, and organizational structure, which can be applicable to the product or process innovation activities (2009:94).
Zheng, Liu and George (2010)	Empirical: Quantitative (Panel data of 170 biotechnology start-ups over 15 years)	The ability to generate novel and useful knowledge or products (2010:594).
Biedenbach and Müller (2012)	Empirical: Qualitative-quantitative (18 interviews and 80 online surveys in European pharmaceutical and biotechnology R&D organisations.	Incremental innovative capability can be defined as the ability to generate innovations that refine and reinforce existing products and services, whereas radical innovative capability is the ability to generate innovations that significantly transform existing products and services (2012:624).

NOTE: *Research papers which do not provide an original definition of the concept have been excluded from the table.

Quintana-Garcia and Benavides-Velasco (2008) found that diversified technology has a positive and significant effect on innovative capability of firms. Quintana-Garcia and Benavides-Velasco's (2008) findings also suggest that technological diversity may mitigate core rigidities (that can be included in the success trap) and path dependencies by enhancing radical innovations that depart from the existing ones. Table 2.4 presents a summary of key research on innovative capability.

Showing some resemblance to Wang and Ahmed's (2007) components of DCs, Pandza and Holt (2007:350) propose two components of DCs, namely absorptive capacity (absorptive capability) and transformative capacity (transformative capability) where absorptive capability is concerned with exogenous technological change, transformative capability describes the capability to constantly redefine a portfolio of product or service opportunities based on knowledge endogenous to the firm. While firms' absorptive capability demonstrate its "ability to recognise the value of new, external information, assimilate it, and apply it to commercial ends" (Cohen and Levinthal, 1990: 128), transformative capability represents firms' ability to strategically adapt themselves in response to environmental change and their ability to innovative new methods of production and new ways of doing things within the firms. Transformative capability is akin to adaptive and innovative capabilities of Wang and Ahmed's (2007) classification. Garud and Nayyar (1994) believe that absorptive and transformative capabilities are complementary organisational capabilities. They further argue that absorptive capability itself is not sufficient for sustaining competitive advantage as, in a continually changing environment, sustainable competitive advantage does not derive from simply reacting to external changes but from changing the "rules of the game" through their own actions (Garud and Nayyar, 1994).

The above discussion reveals that recognising the capabilities in hierarchical order helps to distinguish between DCs and other capabilities of firms. Furthermore, it came to light that DCs are not something just unique to a firm and they have commonalities across firms. What is unique is the way firms use DCs in reconfiguring its resources and creating new capabilities. Strengthening the arguments that there are commonalities of DCs across firms, literature presents different components of DCs. However, out of different classifications of components of DCs, Wang and Ahmed's (2007) three component factors offers clear direction towards operationalising the DCs construct. This is particularly useful

as the three components are conceptually distinct, but complementary components of DCs. The three components are conceptually distinct as each has its own emphasis (Wang and Ahmed, 2007): (a) adaptive capability stresses a firm's ability to adapt itself by aligning resources and capabilities with environmental changes; (b) absorptive capability highlights the importance of acquiring external knowledge, assimilating with internal knowledge for internal use; and (c) innovative capability explains, using inherent innovativeness, how firm's resources and capabilities can be converted to marketplace-based advantage in terms of new products and/or markets. However, all three components "together explain firm's mechanism of linking internal resource advantage to external marketplace-based competitive advantage" (Wang and Ahmed, 2007:36-37). For example, Deeds, DeCarolis and Coombs (1999) point out that a firm's innovative capability largely depends on its absorptive capability. Adaptive capability is more about capitalising on opportunities created by change in the environment and it specially focuses on changing organisational forms or, as claimed by Rindova and Kotha (2001), on 'continuous morphing' which include continuous changes in products, services, resources, capabilities and modes of organisation. Table 2.5 presents the components of DCs (Wang and Ahmed, 2007) and their definitions that are used in this study.

Table 2.5. Definitions of the Components of DCs

Component	Definition
Adaptive capability	The capacity to reconfigure activities in the business unit quickly to meet changing demands in the task environment (Gibson and Brinkinshaw, 2004:209).
Absorptive capability	The ability of a firm to recognize the value of new information, assimilate it, and apply to commercial ends (Cohen and Levinthal, 1990:128).
Innovative capability	Capability of introducing new products to the market, or opening up new products to the market, opening up new markets, through combining strategic orientation with innovative behaviour and process (Wang and Ahmed, 2004:304).

2.4. Summary

This chapter reviewed the RBV and the DCs perspective of strategic management which this study is mainly based on. Acknowledging the main criticisms against the RBV, the DCs perspective that addresses key issues of the RBV was reviewed and clarified in light of relevant conceptual and empirical work available in the extant literature. In doing so, the construct of DCs was identified as capabilities of a firm to change its internal and external resources in response to changing internal or external environment. Among many classifications of the components of DCs, it was recognised that Wang and Ahmed's (2007) three component factors of DCs, i.e. adaptive capability, absorptive capability and

innovative capability offer the broadest classification, particularly in operationalising DCs and in understanding the commonalities of DCs across firms.

Chapter 3: The Research Model and Hypotheses

3.1. Introduction

Drawing on conceptual and empirical evidence available in the extant literature, this chapter formulates research hypotheses that lead to the research model of the study. Seven hypotheses are derived based on the tentative relationships among the key constructs the success trap, market dynamism, DCs, exploratory capabilities, exploitative capabilities and firm performance. The chapter presents the research model of the study that depicts the hypothesised relationships among the above constructs.

3.2. Antecedents of Dynamic Capabilities

DCs reflect a firm's ability to gain competitive advantage in a new and innovative way (Teece, Pisano and Schuen, 1997). Furthermore, a firm's ability to continuously create, define, discover and exploit entrepreneurial opportunities may depend on its ability to develop and apply different DCs (Zahra, Sapienza and Davidson, 2006). In addressing the question why some firms are better in developing and applying DCs than others, it is important to identify the antecedents of DCs. Antecedents of DCs can be found at individual level, firm level, or network level (Eisenhardt and Martin, 2000; Teece, Pisano and Schuen, 1997; Zollo and Winter 2002). As far as the firm-level antecedents of DCs are concerned, as it is evident from conceptual and empirical work in the literature, the main focus has been on factors such as the role of top management (e.g. Kor and Mahoney, 2005; O'Reilly and Tushman, 2008), research and development (R&D) investment (e.g. Kor and Mahoney, 2005), internal (learning) processes (e.g. Zollo and Winter, 2002; Zahra, Sapienza and Davidson, 2006), social capital (e.g. Blyler and Coff, 2003), and market dynamism (e.g. Eisenhardt and Martin, 2000; Wang and Ahmed, 2007).

Regarding the role of top management as a potential internal antecedent of DCs, McGuinness and Morgan (2000:211) argue that managers have limitations in terms of "identifying core competencies or core capabilities" and controlling "historically identified organizational capabilities" which are subject to change. This might reduce the relevance of top management as an antecedent of DCs. R&D investment, another possible internal antecedent of DCs, has been used as a proxy for absorptive capability (e.g. Cohen and Levinthal, 1990) which has been suggested as a component of DCs. Thus, it seems that R&D investment is more of an indicator of DCs rather than an antecedent.

As suggested by Zollo and Winter (2002), organisational internal learning mechanisms are the key antecedent of DCs. Such learning processes capture external knowledge (Zahra, Sapienza and Davidson, 2006). However, learning has its own traps, which are mainly of two types, i.e. the "success trap" that is caused by excessive focus on past success and the "failure trap" that is caused by recurring failures (Levinthal and March, 1993).

Such traps can be associated with the path-dependent nature of DCs. For example, in their seminal article, Cohen and Levinthal (1990) stress that absorptive capability is path dependent. Cohen and Levinthal (1990) discuss how prior knowledge should be closely related to the new knowledge to facilitate assimilation. However, Arthurs and Busenitz (2006) point out how organisations with an established resource base are likely to have inherent rigidities (Leonard-Barton, 1992). Such rigidities are resulted by the aggregation of stocks of capabilities (Dierickx and Cool, 1989) and are related to the pursuit of a former opportunity.

Therefore, firms need DCs to reconfigure their resource base (Eisenhardt and Martin, 2000) to develop entrepreneurial capabilities to identify and pursue new opportunities. Accordingly, recognising path-dependent absorptive capability as a component of DCs, and the above perceived effect of DCs on entrepreneurial capabilities would legitimise investigating the effect of the success trap on DCs as an as an internal antecedent. Out of the two main types of learning traps, this study focuses on the "success trap" and not on the "failure trap" (Levinthal and March, 1993). Further details can be found in the section on the success trap.

As far as external factors are concerned, Blyler and Coff (2003) admit that social capital is a necessary, though not sufficient, antecedent of DCs. Apart from some evidence from secondary source, Blyler and Coff (2003) do not provide concrete empirical evidence to support their proposition of social capital as an antecedent of DCs. As a potential external antecedent, market dynamism has garnered a significant level of attention in the DCs literature. Eisenhardt and Martin (2000) argue that effective patterns of DCs depend on market dynamism. Zahra, Sapienza and Davidson (2006) also maintain that market dynamism plays a key role in developing DCs. Tripsas (1997) and Cui, Griffith and Cavusgil (2005) provide empirical evidence regarding such relationships. However, both Tripsas's (1997) and Cui, Griffith and Cavusgil's (2005) studies have their limitations: the

former being limited to three cases and the latter being based on a limited measure of dynamic knowledge management capabilities. More importantly, as discussed in Chapter 2, by definition, DCs represent a firm's ability to respond to the changing environment (e.g. Danneels, 2010; Eisenhardt and Martin, 2000; Macpherson, Jones and Zhang, 2004; Salvato and Rerup, 2010; Teece, Pisano and Schuen, 1997; Wang and Ahmed, 2007). However, restricting DCs to dynamic environments has been a major criticism (e.g. Zollo and Winter, 2002) against the original definition of DCs (Teece, Pisano and Schuen, 1997). Thus, it is worth examining if market dynamism is an external antecedent of DCs.

Thus, the success trap, as a potential internal antecedent, and market dynamism, as a potential external antecedent of DCs, are discussed next.

3.2.1. The Success Trap and Dynamic Capabilities

DCs arise from learning (Teece, Pisano and Schuen, 1997; Zollo and Winter, 2002). Levinthal and March (1993) identify two types of learning: exploratory learning (exploration) and exploitative learning (exploitation). Exploratory learning involves "search, variation, risk taking, experimentation, play, flexibility, discovery, innovation", and exploitative learning involves "refinement, choice, production, efficiency, selection, implementation, execution" (March, 1991: 71). While claiming the difficulty in determining the balance between exploratory learning and exploitative learning, Levinthal and March (1993) point out how organisational learning itself could lead to imbalances between the two types of learning causing two types of learning traps that were mentioned above: the failure trap and the success trap. As defined by Levinthal and March (1993:105-106) the success trap occurs as [firms] "develop greater and greater competence at a particular activity, they [firms] engage in that activity more, thus further increasing competence and the opportunity cost of exploration" whereas the failure trap occurs as "failure leads to search and change which leads to failure which leads to more search, and so on". Im and Rai (2008) also claim that each learning type is inherently self-reinforcing and can cause a success trap or a failure trap. Exploration often leads to failure due to the broad dispersion in the range of possible outcomes, and failure promotes the search for even newer ideas and more exploration, thereby creating a failure trap (Gupta, Smith and Shalley, 2006). In contrast, exploitation often leads to early success, which in turn reinforces further exploitation along the same trajectory, thereby creating a success trap (Gupta, Smith and Shalley, 2006). In summary, the success trap may lead to excessive

exploitation at the cost of exploration required for long-term sustainability whilst failure traps may lead to excessive exploration negating short-term commercial benefits (Levinthal and March, 1993).

Since the construct learning traps was first introduced by Levinthal and March (1993), different authors have discussed different aspects of the concept using different terms: for example, decision traps (Augier and Teece, 2008), core rigidities (Leonard-Barton, 1992), competency trap (Levitt and March, 1988) and organisational pathologies (Ahuja and Lampert, 2001). Augier and Teece (2008) discuss decision traps and emphasise that firms must avoid them as they lead to biased decisions. Introducing the phenomena core capabilities and core rigidities, Leonard-Barton (1992:113-114) defines core capability as "the knowledge set that distinguishes and provides a competitive advantage" and presents four dimensions of 'the knowledge set' or core capabilities: knowledge and skills in employees; knowledge embedded in technical systems; managerial systems of formal and informal knowledge creation; values and norms in the content and structure of knowledge. It came to light in Leonard-Barton's (1992:118) study that core capabilities of firms can become core rigidities, i.e. "inappropriate sets of knowledge", in all four dimensions above.

As described by Zahra, Sapienza and Davidson (2006), current routines or procedures represent substantive capabilities of a firm whereas abilities to change those routines or procedures correspond to DCs. Firms might become trapped in existing capabilities due to the path-dependent nature of capability development process or the local search process of capabilities (Keli, 2004).This had already been observed by Levitt and March (1988) who claimed if a firm continues to improve and use its competencies within the same set of routines or procedures even if it leads to superior performance in the short run, the firm may be caught in a "competency trap" putting it in an unfavourable situation in the long run. For example, Christensen (1993) observes that having aggressively developed the new component technologies, the excessive attention to address their leading customers' needs caused leading disk drive makers to ignore a sequence of emerging market segments making them displaced by more innovative new entrants. The above concept of competency trap has a close resemblance to Levinthal and March's (1993) success trap.

Out of the two learning traps above (Levinthal and March, 1993), Lee and Van den Steen (2010) reckon that success trap may have stronger impact on firm performance than failure trap does. They argue that the direct informational value of successful practices is higher than that of failures, because information about a success tells employees exactly what to do, whereas information about a failure only excludes one of many possible courses of actions. This explains why firms want to share best practices and replicate success and why success has more prominence than failure (Lee and Van den Steen, 2010). Minocha and Stonehouse's (2006: 1355) definition of learning traps also highlights the key role of the success trap within the domain of learning traps: "organisation and its processes are unable to look beyond past success in informing current practice".

Table 3.1. Selected Research on the Success Trap*

Author/s and the Year	Type/Approach	Definition
Levitt and March (1988)	Conceptual	A *competency trap* can occur when favourable performance with an inferior procedure leads an organization to accumulate more experience with it, thus keeping experience with a superior procedure inadequate to make it rewarding to use (1988:322).
Leonard-Barton (1992)	Empirical (20 case studies of new product and process development projects in five firms)	*Core rigidities*-inappropriate sets of knowledge (1992:118).
Levinthal and March (1993)	Conceptual	*The success trap*- As they [firms] develop greater and greater competence at a particular activity, they engage in that activity more, thus further increasing competence and the opportunity cost of exploration (1993:106).
Ahuja and Lampert (2001)	Empirical (Study in the global chemicals industry)	*The familiarity trap- A* tendency to favour the familiar over the unfamiliar (2001:531).
		The maturity trap-a tendency to prefer the mature over the nascent (2001:531).
		The propinquity trap-a tendency to search for solutions that are near to existing solutions rather than search for completely new solutions (2001:531).
Minocha and Stonehouse (2006)	Empirical: Qualitative (Two cases of Bollywood film industry)	[Learning trap is a condition where] the organisation and its processes are unable to look beyond past success in informing current practice (2006:1355).
Assink (2006)	Conceptual	Learning traps embody the conflict between efficient routines and processes to continue successful businesses and the need to challenge these capabilities to bring about future disruptive innovation (2006:223).
Gupta, Smith and Shalley, 2006)	Conceptual	Exploration often leads to early success, which in turn reinforces further exploitation along the same trajectory, thereby creating a "success trap" (2006: 695).
Lee and Van den Steen (2010)	Conceptual	[A competency trap/success trap is] the simple fact of knowing about the moderately successful practice inefficiently reduces the incentives for employees to experiment (2010: 276).

NOTE: *Research papers which do not provide an original definition of the concept have been excluded from the table.

In addition, Assink (2006) also stresses the role of the success trap in describing learning traps: learning traps exemplify the conflict between efficient routines and processes to continue successful businesses and the need to develop new capabilities to produce future disruptive innovation. Therefore, this study focuses on the influence of the success trap on DCs of firms and adopts Levinthal and March's (1993:106) definition of the success trap: "As they [firms] develop greater and greater competence at a particular activity, they engage in that activity more, thus further increasing competence and the opportunity cost of exploration".

Based on the evidence from the chemical industry, Ahuja and Lampert (2001) suggest that the success trap can be observed under three types of organisational pathologies which hinder breakthrough inventions in firms: the familiarity trap (a tendency to favour the familiar over the unfamiliar), the maturity trap (a tendency to prefer the mature over the nascent) and the propinquity trap (a tendency to search for solutions that are near to existing solutions rather than search for completely new solutions). The above three traps are interrelated and a firm can be caught in all three traps at varying levels (Ahuja and Lampert, 2001). In other words, the extent to which a firm is caught in the above three traps can be placed on a continuum. For example, a firm can be trapped in one trap at a high level whereas at a low level in another trap among the three traps above. Table 3.1 presents a summary of selected work on the success trap.

Literature provides further evidence related to the perceived effect of the success trap on DCs. As it was evident in the world disk drive industry, established firms were adversely affected by the success trap: established firms led the industry in developing technologies that addressed the needs of existing customers only and failed to develop technologies that were initially useful in emerging markets and later invaded mainstream markets giving the new entrants victory over established firms (Christensen and Bower, 1996). In addition, Rosenkopf and Nerkar (2001) confirm that the danger of such traps is real in the optical disk industry. O'Reilly and Tushman (2008) observe how previous success, i.e. relying on existing competencies, made Southwest Airlines slower than competitors like JetBlue Airways in exploiting new advances in technology. Danneels (2007) also reports that the firm's strong customer competence in serving the analytical laboratory market made exploration of non-analytical markets unattractive.

As identified by Ahuja and Lampert (2001) the familiarity trap, the maturity trap, the propinquity trap, which form the success trap, hinder breakthrough inventions in large firms. Particularly, since Ahuja and Lampert's (2001) study was focused on large firms, it would be useful to see how the success trap works in the SME context. From the findings of the above researchers and the proposition developed by Zahra, Sapienza and Davidson (2006) it can be derived that firms caught in the success trap tend to repeat their substantive capabilities without developing or exercising DCs. Therefore it is hypothesised that:

H_1: The success trap has a negative influence on dynamic capabilities of a firm.

3.2.2. Market Dynamism and Dynamic Capabilities

Environment plays a major role in shaping the behaviour of firms. Specially, dynamic market environments create uncertainty for firms. Factors such as industry technological innovation, regulatory change, economic cycle and the changing competitive nature of the industry can cause dynamic market environments (Wang and Ahmed, 2007). Only one firm among three leading firms could survive and prosper in the radical, competence destroying technological change in the typesetter industry (Tripsas, 1997). The development of the battery electric vehicle posed both strategic and technological problems for the established incumbents in the automobile industry (Dyerson and Pilkington, 2000). The regulatory change that transformed the Hollywood movie industry from the studio era to post-studio era resulted in new organisational forms (Lampel and Shamsie, 2003). United States' regulatory moves towards zero emission standards demanded a radical technological change in the automobile industry (Pilkington and Dyerson, 2006). Industry change influences creation and use of DCs (Winter, 2003). In a recent study, Barrales-Molina, Bustinza and Gutiérrez- Gutiérrez (2012) conclude that only firms whose managers perceive a high degree of environmental dynamism generate DCs. These findings also support potential influence of market dynamism on development of DCs.

Miller and Friesen (1983:222) define environmental dynamism as "the rate of change and innovation in the industry as well as the uncertainty or unpredictability of the actions of competitors and customers". In other words, dynamism is mainly manifested by "the amount and unpredictability of change in customer tastes, production or service

technologies, and the modes of competition in the firm's principal industries" (Miller and Friesen, 1983:233). External pressure on firms includes rapid changes in technology, consumer economics, social values, and political actions and regulatory standards (Stevenson and Gumpert, 1985). Thus, market dynamism can be a result of changes in customers, competitors (Jaworski and Kohli, 1993; Miller and Friesen, 1983), technology (Jaworski and Kohli, 1993; Lavie, 2006; Stevenson and Gumpert, 1985; Tripsas, 1997), regulations (Lampel and Shamsie, 2003; Pilkington and Dyerson, 2006; Stevenson and Gumpert, 1985), and the changes in the economy at large.

Jaworski and Kohli (1993) looked at three characteristics of environmental context of an organisation: market turbulence (the rate of change in the composition of customers and their preferences), competitive intensity (the level of competition in the market) and technological turbulence (the rate of technological change).

Table 3.2. Selected Research on Market Dynamism*

Author/s and the Year	Type/Approach	Definition
Jaworski and Kohli (1993)	Empirical: Quantitative (Two samples of marketing and nonmarketing executives in the US)	Identified three characteristics of 'environmental context of organizations' [or Dynamic market environments]: (1)*Market turbulence*- 'the rate of change in the composition of customers and their preferences'; (2)*Competitive intensity*-'the level of competition in the market'; (3)*Technological turbulence*- 'the rate of technological change'.
Miller and Friesen (1983)	Empirical (Quantitative study in Canadian firms across 15 industries)	Environmental dynamism (Market dynamism) is 'the rate of change and innovation in the industry as well as the uncertainty or unpredictability of the actions of competitors and customers' (1983:222).
Cui, Griffith and Cavusgil (2005)	Empirical (300 FDIs of MNC in Croatia)	Market dynamism refers to the degree of change in the market. Market dynamism includes changes of various market elements, such as customer demand, technology, and competitor structure (2005:37).
Lavie (2006)	Conceptual	Defines technological change as 'an exogenous technical innovation that modifies the components, systems, techniques, or methods required for producing organizational outputs' (2006:154).
Adjei, Griffith and Noble (2009)	Empirical: Quantitative (A sample of 172 small retailers in the US)	Market dynamism is the degree of frequent change in the market, where the more frequent change occurs in the market the greater the market dynamism (2009:495).
Fang and Zou (2009)	Empirical: Quantitative (200 Chinese manufacturing IJVs)	Market dynamism refers to changes in customers' and competitors' behaviors that occur frequently and are difficult to predict (2009:749).
Drnevich and Kriauciunas (2011)	Empirical (48 Chilean firms that contained multilevel data)	[Environmental dynamism is] a change in the competitive environment that affects how firms compete with each other and how they respond to customer needs and developments in the industry (2011:255).

NOTE: *Research papers which do not provide an original definition of the concept have been excluded from the table.

According to Cui, Griffith and Cavusgil (2005:37) market dynamism refers to "the degree of change in the market" and market dynamism includes "changes of various market elements, such as customer demand, technology, and competitor structure". Cui, Griffith and Cavusgil (2005) derive two dimensions of market dynamism: (1) the environmental demands on the firm are constantly changing and (2) the business practices in the industry are constantly changing. Market elements such as customer demand, technology and competitor structure cause market dynamism (Cui, Griffith and Cavusgil, 2005). Therefore, following Jaworski and Kohli (1993) and Cui, Griffith and Cavusgil (2005), this study defines market dynamism as the rate of change in the composition of customers and their preferences, the level of competition in the market, and the technology. Table 3.2 presents selected research on market dynamism.

Scholars argue that market dynamism can particularly influence DCs of firms. Firms have to reconfigure or revise their capabilities in the dynamic environments (March, 1991; Zahra, Sapienza and Davidson, 2006). According to Eisenhardt and Martin (2000), market dynamism determines the pattern of effective DCs: in frequently moderate markets, effective DCs rely heavily on existing knowledge whereas in high velocity markets DCs necessarily rely more on rapidly creating situation-specific new knowledge. Ambrosini, Bowman and Collier (2009) suggest three levels of DCs that are identified in relation to perceived environmental states, i.e. "incremental" DCs that are associated with stable environments, "renewing" DCs that are connected to dynamic environments, and "regenerative" DCs that are applicable in hyper environments.

As far as the key elements of market dynamism are concerned, Lavie (2006:154) argues that technological change could affect DCs of a firm. In addition to the direct effect on DCs, technological change indirectly influence the intensity of competition, the level of environmental uncertainty, structural conditions such as barriers to entry and mobility, economies of scale and scope, demand conditions, and customer preferences (Lavie, 2006). As suggested in Lavie's (2006) model, characteristics of technological change, the attributes of capabilities and path dependencies affect the choice of reconfiguration mechanism that determine the capacity of firms to reduce capability gaps. These findings complement those of Tripsas (1997).

Further evidence related to the possible effect of market dynamism on the components of DCs can be found in the literature. Volberda (1996) concludes that capabilities generate rents in hypercompetitive environments. In such environments, to efficiently respond to competitive changes that are not predictable, firms need superior adaptive capabilities (Volberda, 1996). High level of market dynamism generates more innovations in firms (Baldrige and Burnham, 1975; Miller and Friesen, 1983; Miller and Friesen, 1984; Utterback, 1971) which is an indicator of the effect of market dynamism innovative capabilities of firms. Firms operating in more dynamic market environments have to be more innovative than firms in less dynamic market environments (Russell and Russell, 1992). However, Miller and Friesen (1983) present contradictory findings in their study of two samples of Canadian and US firms about the relationship between environmental hostility and innovation. They found that the relationship between hostility and innovation was negative for Canadian firms whereas it was a positive for US firms. Based on the above contradictory results among successful and unsuccessful firms in the two samples, Miller and Friesen (1983:229) further conclude that "The results may be suggesting that hostility does not have any simple relationship to innovation that it depends upon the state of the firm's resources and the precise nature of competitive threats. But much more research is needed on this question".

Even though Zahra, Sapienza and Davidson (2006) propose that major or continual environmental change can increase the development and use of DCs, they argue that the need for change of routines may arise from changes in organisational conditions rather than in the external environment. This is consistent with Delmas (2002) who suggests that institutional context can play a role in promoting or hindering DCs of a firm. On the other hand, even though they agree with the Eisenhardt and Martin's (2000) idea that DCs themselves do not lead to superior performance, Zahra, Sapienza and Davidson (2006) maintain that potential gain from DCs is greater in dynamic environments. These tensions connected to the influence of market dynamism on DCs demand better theorising and an empirical investigation into the effect market dynamism on DCs of firms. Therefore, it is hypothesised that:

H_2: Market dynamism has a positive influence on dynamic capabilities of a firm.

3.3. Consequences of Dynamic Capabilities

This section identifies entrepreneurial capabilities of a firm as possible consequences of their DCs. In doing so, first the concept of entrepreneurial capabilities is discussed where exploratory capabilities and exploitative capabilities are identified as core entrepreneurial capabilities of firms. In light of conceptual and empirical evidence, the discussion leads to development of research hypotheses on the influence of DCs on exploratory capabilities and exploitative capabilities.

Extant literature indicates that there is no agreement among scholars of entrepreneurship about a clear-cut definition for the concepts of entrepreneur and entrepreneurship. The concept of entrepreneurship has been discussed at different levels and from different perspectives. However, Stevenson's (2000:1) definition of entrepreneurship, i.e. entrepreneurship is "the pursuit of opportunity beyond the resources you currently control", provides a comprehensive view of the concept. Stevenson (2000) focuses on both the individual and the society in his definition: entrepreneurship is about an individual receiving an opportunity as an entrepreneur and seeking resources from the broader society. Furthermore, Stevenson and Gumpert (1985) view entrepreneurship as a behaviour and not as a trait. This is evident in Stevenson's (2000) work on entrepreneurship that emphasise the "how" of entrepreneurship rather than the "who" or "what".

Different views on "entrepreneur" that are available in the extant literature can be categorised under several themes: (a) based on economic and management point of view and (b) based on the level of analysis. From an economic point of view entrepreneurs are described as agents who combine resources in the economy and they are risk takers motivated by profit (e.g. scholars Richard Cantillon, Jean Baptiste Say, Harvey Leibenstein, and Frank Knight). From a management point of view entrepreneurs are described as the people who create and innovate and see opportunities and act upon them (e.g. scholars Joseph Schumpeter, Peter Drucker, Israel Kirzner and Brian Dabson). Based on the level of analysis, at individual level, entrepreneur is an individual or an agent who takes risk, makes judgemental decisions, create value, lead others and see opportunities (e.g. scholars Richard Cantillon, Jean Baptiste Say, Harvey Leibenstein, Frank Knight, Israel Kirzner and Mark Casson); and at organisational level, entrepreneurship can be in teams or in organisations (e.g. scholars Joseph Schumpeter, Peter Drucker and David A.

Harper). Furthermroe, Davidsson and Wiklund (2001) classify the level of analysis into two complementary levels: micro level (e.g. individual, team and firm levels) and macro level (e.g. regional and national levels).

Next, the concept of entrepreneurship is briefly reviewed from the lense of the RBV that is the overaching theory of this study. Penrose (1959:31) describes the term entrepreneur as "individuals or groups within the firm providing entrepreneurial services, whatever their position or occupational classification may be". It is the entrepreneurs in firms who effectively use its resources in identifying and exploiting opportunities. Penrose (1959:34) claims that "The enterprising firm will permanently commit part of its resources to the task of investigating the possible avenues for profit expansion" or opportunities for growth. Based on Penrose (1959) and developing a subjectivist theory of entrepreneurship, Kor, Mahoney and Michael (2007) conclude that the subjectivity of the entrepreneurial opportunities envisioned by the entrepreneur can partly come from the entrepreneur's knowledge of the firm's unique bundle of resources and capabilities. Barney (2001) points out the need for an interface to link the RBV and entrepreneurship. According to Alvarez and Busenitz (2001), an understanding of how entrepreneurial actions create new heterogeneous resources would extend the boundaries of the RBV. Alvarez and Busenitz (2001) define recognition and opportunity seeking behaviour as a resource and the process of combining and organising resources also as a resource. Thus, Alvarez and Busenitz (2001:756-757) define entrepreneurship within the RBV as "the recognition and exploitation of opportunities that result in the creation of a firm that seeks to obtain entrepreneurial rents".

In addition, Burgelman's (1983:1349) definition of entrepreneurship at firm level, i.e. "the process whereby firms engage in diversification through internal development", also indicates the relationship between resources and entrepreneurship. Furthermore, Burgelman (1983) distinguishes between external and internal entrepreneurship: external entrepreneurship deals with resources in the environment whereas internal entrepreneurship involves new resource combinations within the organisation.

3.3.1. Dynamic Capabilities and Entrepreneurial Capabilities

The focus of this study is on entrepreneurial capabilities at firm-level. The two overlapping concepts strategic entrepreneurship and corporate entrepreneurship help to understand

entrepreneurial capabilities at firm-level. Strategic management provides time and purposive direction into a business whereas entrepreneurship seeks to enhance creativity of human action (Venkataraman and Sarasvathy, 2001). Combination of entrepreneurship and strategic management has evolved into strategic entrepreneurship that refers to "entrepreneurial action with a strategic perspective" and strategic entrepreneurship integrates entrepreneurial (i.e. opportunity seeking behaviour) and strategic (i.e. advantage seeking) perspectives in developing and taking actions designed to create wealth (Hitt et al., 2001:480). In strategic entrepreneurship, a firm combines exploration-oriented attributes with exploitation-oriented attributes to develop consistent streams of innovation and to remain technologically ahead of competitors (Ireland and Webb, 2007).

Barringer and Bluedorn (1999) reckon that a firm's entrepreneurial intensity is influenced by the nature of its strategic management practices that include scanning intensity, planning flexibility, planning horizon and locus of planning. Morris, Kuratko and Covin (2008) state that corporate entrepreneurship describes entrepreneurial behaviour inside established mid-sized and large organisations and "organisational entrepreneurship", "intrapreneurship" and "corporate venturing" are alternative terms for corporate entrepreneurship. More precisely, Burgelman (1983:1349) defines corporate entrepreneurship as "the process whereby firms engage in diversification through internal development" and "such diversification requires new resource combinations". The role of entrepreneurship is to provide this diversity (Burgelman, 1984) that requires new resource configurations.

It is understood that corporate entrepreneurship is associated with large organisations in general. However, this does not lessen the value of studying firm-level entrepreneurial capabilities of small and medium sized firms. For example, in a study of 660 "technological small firms" and "traditional small firms", Borch et al. (1999) highlight the importance of studying small firms from a behaviour perspective rather than focusing only on decisions and characteristics of small business managers. This approach is in line with Covin and Slevin's (1991) idea of entrepreneurship as firm behaviour. This justifies exclusion of managers as an influential factor in studying DCs and entrepreneurial capabilities of small firms. However, particular recurring behavioural patterns, which reflect the top management's overall strategic philosophy, can be observed in

entrepreneurial firms (Covin and Slevin, 1991) that are characterised by risk-taking, innovative and proactive nature (Miller, 1983; Covin and Slevin, 1991).

Covin and Slevin (1991) argue that, unlike traditional entrepreneurial approaches, which focus on the traits of individual entrepreneurs, a firm level model of entrepreneurship is more appropriate as entrepreneurial effectiveness is a firm level phenomenon. Such entrepreneurial traits are just one element of the entrepreneurial process (Gartner, 1989). Even though individual behaviour is important and it influences the firm level behaviour, the latter is a predictor of the key entrepreneurial effectiveness criterion (Covin and Slevin, 1991). Entrepreneurial behaviour at firm-level can be managed through creation of appropriate organisational strategies, structures, systems and cultures (Covin and Slevin, 1991).

Based on an analysis of the entrepreneurship literature, Stevenson and Jarillo (1990) identify three streams of research in entrepreneurship: *what* happens when entrepreneurs act, *why* entrepreneurs act, and *how* entrepreneurs act. While claiming that neither function nor character would help understand entrepreneurship in managerial terms, Stevenson and Jarillo (1990) point out that focussing on entrepreneurial process that involves pursuing opportunities would be useful for understanding entrepreneurship. Thus, regardless of the resources under control, the essence of entrepreneurship is the willingness to pursue opportunity (Stevenson and Jarillo, 1990). This pursuit of opportunities could be by individuals either on their own or inside organisations (Stevenson et al., 1989).

When the firms grow and become complex, a need arises continually for organisational renewal, innovation, constructive risk-taking, and the conceptualisation and pursuit of new opportunities going beyond the efforts of one key manager (Miller, 1983). Entrepreneurial firm is defined as the "one that engages in product-market innovation, undertakes somewhat risky ventures, and is first to come up with "proactive" innovations, beating competitors to the punch" (Miller, 1983:771). Thus, firms which are risk taking, innovative and proactive indicate availability of firm-level entrepreneurial capabilities (Covin, Green and Slevin, 2006). Moreover, autonomy and competitive aggressiveness of firms also indicate firm-level entrepreneurial capabilities.

There is a call for research on how firms manage firm-level entrepreneurial behaviour (e.g. Wiklund and Shepherd, 2003; Covin, Green and Slevin, 2006). In addition, past researchers have attempted to operationalise entrepreneurship at firm-level. Covin and Slevin (1989) develop a nine-item scale which consists of original items as well as those adapted from Miller and Friesen (1982) and Khandawalla (1976/77) to measure the entrepreneurial strategic postures of small firms. As proposed by Miller (1983), at firm level, what is most important is not the critical actor, i.e. a key manager or a department, but the process of entrepreneurship and the organisational factors which foster and impede it. However, Miller's (1983) measure does not explicitly and directly address the extent of firms' involvement in the recognition or exploitation of an opportunity (Brown, Davidsson and Wiklund, 2001). Therefore, Brown, Davidsson and Wiklund (2001) developed a 20-item measure for the entrepreneurial management along six dimensions that are based on Stevenson (1983), i.e. strategic orientation, resource orientation, management structure, reward philosophy, growth orientation and entrepreneurial culture.

Kirzner (1979) emphasises that "alertness to opportunities" is the key to entrepreneurship. An 'opportunity' is defined as "a future situation which is deemed desirable and feasible" (Stevenson and Jarillo, 1990:23). "Entrepreneurial opportunities" are the situations in which new goods, services, raw materials, markets and organising methods can be introduced through the formation of new means, ends, or means-ends relationships (Eckhardt and Shane, 2003). Pursuing opportunity constitute the core of entrepreneurship at both individual and corporate levels (Stevenson and Jarillo, 1990). Detection of opportunity, willingness to pursue it, and confidence and the possibilities of succeeding are key components of the entrepreneurial process (Stevenson and Jarillo, 1990). However, opportunity is a relative concept which varies among individuals and over time because individuals have different desires and perception of their capabilities; capabilities depend on innate skills, training and the competitive environment (Stevenson and Jarillo, 1990).

Entrepreneurial capabilities at firm-level are mainly associated with exploration and exploitation of profitable opportunities (Alvarez and Busenitz, 2001; Shane and Venkataraman, 2000). As mentioned earlier, "exploration" deals with search, variation, risk taking, experimentation, play, flexibility, discovery, innovation whereas "exploitation" involves refinement, choice, production, efficiency, selection, and implementation and execution (March, 1991). Lumpkin and Lichtenstein (2005:457) argue that organisational

learning can strengthen a firm's ability to recognise opportunities and pursue new ventures. Choi, Lévesque and Shepherd (2008) propose that the timing of opportunity exploitation depends on the degree of novelty of the opportunity identified. Exploration challenges existing ideas with innovative and entrepreneurial concepts whereas exploitation helps a firm to secure a comfortable position in the marketplace by committing firm's resources to ensure the current viability of the firm against its competitors (Auh and Menguc, 2005).

Following March (1991), Brady and Davis (2004:1604) describe exploitation as "the routine behaviour involved in refining a firm's current capabilities and improving the performance of existing routines" whereas exploration "refers to the innovative behaviour

Table 3.3. Selected Research on Exploration and Exploitation

Author/s and the Year	Type/Approach	Definition	
		Exploration	**Exploitation**
March (1991)	Empirical: Quantitative (Simulated data)	Exploration includes things captured by terms such as search, variation, risk taking, experimentation, play, flexibility, discovery, innovation (1991:71).	Exploitation includes such things as refinement, choice, production, efficiency, selection, implementation, execution (1991: 71).
Brady and Davis (2004)	Empirical: Qualitative (In-depth case studies Ericsson and Cable & Wireless-C&W)	Exploration refers to the innovative behaviour involved in risk-taking and experimenting with unfamiliar alternatives (2004:1604).	Exploitation refers to the routine behaviour involved in refining a firm's current capabilities and improving the performance of existing routines (2004:1604).
He and Wong (2004)	Empirical: Quantitative (137 firms from Singapore and 69 firms from Malaysia)	Exploration implies firm behaviors characterized by search, discovery, experimentation, risk taking and innovation (2004:481).	Exploitation implies firm behaviors characterized by refinement, implementation, efficiency, production and selection (2004:481).
Atuahene-Gima (2005)	Empirical: Quantitative (127 electronics firms in China)	Competence exploration refers to the tendency of a firm to invest resources to acquire entirely new knowledge, skills, and processes (2005:62).	Competence exploitation refers to the tendency of a firm to invest resources to refine and extend its existing product innovation knowledge, skills, and processes. Its aims are greater efficiency and reliability of existing innovation activities (2005:62).
Yalcinkaya, Calantone and Griffith (2007)	Empirical: Quantitative (111 U.S. importers)	[Exploration capabilities are] the importer's ability to adopt new processes, products, and services that are unique from those used in the past (2007:66).	[Exploitation capabilities are] the importer's ability to improve continuously its existing resources and processes (2007:66).
Ireland and Web (2007)	Conceptual	Exploration represents a learning process in which the firm attempts to significantly broaden and deepen its total stock of knowledge (2007:53).	Exploitation rests on knowledge of a proven innovation (i.e., product, process, or administrative), making it possible for firms to be aware of present needs and demands (2007:53).
Greve (2007)	Empirical: Quantitative (13 Japanese shipbuilding firms)	Exploration is search for new knowledge, use of unfamiliar technologies, and creation of products with unknown demand (2007:945).	Exploitation is use and refinement of existing knowledge, technologies, and products, and has more certain and proximate benefits (2007:945).

O'Reilly and Tushman (2008)	Conceptual	Exploration is about search, discovery, autonomy, innovation and embracing variation (2008:189).	Exploitation is about efficiency, increasing productivity, control, certainty, and variance reduction (2008:189).
Choi, Lévesque and Shepherd (2008)	Conceptual	Opportunity exploration encompasses activities from multiple milestones including concept and product testing, completion of prototype, completion of initial plant tests, and market testing (2008:335).	Opportunity exploitation- 'building efficient, full-scale operations for products or services created by, or derived from, a business opportunity' (2008:335).
Quintana-Garcia and Benavides-Velasco (2008)	Empirical: Quantitative (US dedicated biotechnology firms)	Exploratory innovative competence represents the ability to perform extensive searches that result in novel methods or materials technologically distant from existing innovations.	Exploitation improves methods or materials (2008:498).
Bierlyl, Damanpour and Santoro (2009)	Empirical: Quantitative (180 firms in the US)	Exploration refers to the application of external knowledge to produce new products and technologies (2009:484).	Exploitation refers to the application of the external knowledge to refine the organization's existing products and improve its processes (2009:484).
Fang, Lee and Schilling (2010)	Empirical: Quantitative (Simulation)	Exploration refers to the search for new, useful adaptations (2010:626).	Exploitation refers to the use and propagation of known adaptations (2010:626).
Prange and Verdier (2011)	Conceptual	Exploitation refers to control, certainty, risk reduction (2011: 128)	Exploration corresponds to discovery, risk-taking, experimentation, flexibility, and innovation (2011: 128)

NOTE: * Research papers that do not provide an original definition of the concepts have been excluded from the table.

involved in risk-taking and experimenting with unfamiliar alternatives". Thus, exploitation deals with current capabilities and exploration look for new capabilities. Moreover, the tendency towards exploration and exploitation depends on the stability of the environment (Brady and Davis, 2004). Following a behavioural approach, He and Wong (2004) claim that exploration implies firm behaviours connected to search, discovery, experimentation, risk taking and innovation, whilst exploitation implies firm behaviours involving refinement, implementation, efficiency, production and selection.

Exploitation is driven by knowledge of a proven innovation, for example, in product, process, or administrative, where firms can be aware of present needs and demands; firms capitalise on market opportunities with high quality products and services enjoy competitive advantage by gaining market share and by forming entry barriers to others (Ireland and Webb, 2007). As far as the types of firms are concerned, Covin, Green and Slevin (2006) observed that conservative firms emphasise exploitation of known opportunities where as entrepreneurial firms are focused on exploration of new opportunities. Table 3.3 presents selected research on exploration and exploitation.

The above discussion reveals that the concepts of exploration and exploitation have been defined mainly from three perspectives: (1) as a behaviour/activity (e.g. Brady and Davis, 2004; Greve, 2007; He and Wong, 2004), (2) as a process (e.g. Ireland and Webb, 2007), and (3) as a competence/capability (e.g. Atuahene-Gima, 2005; Yalcinkaya, Calantone and Griffith, 2007; Quintana-Garcia and Benavides-Velasco, 2008). In this study, exploration and exploitation are considered as entrepreneurial capabilities of a firm. Accordingly, exploratory capabilities and exploitative capabilities are measured from an input perspective and not from an outcome perspective.

One of the main objectives of this study is to examine how DCs could influence exploratory capabilities and exploitative capabilities of firms. March (1991) emphasises the danger of firms focusing on exploration over exploitation and *vice-versa*. The firms which possess higher exploratory as well as exploitative capabilities are the ambidextrous firms (O'Reilly and Tushman, 1996). Furthermore, ambidextrous firms are characterised by an alignment between the characteristics of both exploratory and exploitative firms and O'Reilly and Tushman (2008) have identified the following characteristics of the ambidextrous firm (Figure 3.1).

Alignment of:	**Exploitative Business**	**Exploratory Business**
Strategic intent	*cost, profit*	*innovation, growth*
Critical tasks	*operations, efficiency, incremental innovation*	*adaptability, new products, breakthrough innovation*
Competencies	*operational*	*entrepreneurial*
Structure	*formal, mechanistic*	*adaptive, loose*
Controls, rewards	*margins, productivity*	*milestones, growth*
Culture	*efficiency, low risk, quality, customers*	*risk taking, speed, flexibility, experimentation*
Leadership role	*authoritative, top down*	*visionary, involved*

Ambidextrous Leadership

Different alignments held together through senior-team integration, common vision and values, and common senior-team rewards.

Figure 3.1. The Scope of the Ambidextrous Organisation

Source: O'Reilly and Tushman (2008:80)

Entrepreneurial capabilities deal with "the ability to identify a new opportunity and develop the resource base needed to pursue the opportunity" (Arthurs and Busenitz, 2006: 199). However, the question is why some firms explore and/or exploit better than others. Zahra, Sapienza and Davidson (2006) propose that one source of these differences lies in firms' ability to develop and apply different DCs. Teece (2007) also views that those enterprises with DCs are 'intensely entrepreneurial'. However, as pointed out by O'Reilly and Tushman (2008:188) what is missing in DCs research is "a clear articulation of those specific capabilities that facilitate exploration and exploitation". Furthermore, Rosenkopf and Nerkar (2001) suggest that further research is needed to identify whether and how organisations build capabilities for boundary spanning activities (exploration) and whether these capabilities are at all transferable between organisational and technological boundary-spanning activities. Rosenkopf and Nerkar's (2001) focus is on 'second-order competence', what they consider as DCs. Thus, Rosenkopf and Nerkar's (2001) suggestion also direct the present study towards identifying the nature of DCs and their relationship with exploratory capabilities and exploitative capabilities.

Some evidence that indicate the influence of DCs on exploratory capabilities and exploitative capabilities of firms is available in the extant literature. Dacko et al. (2008) identify four DCs that influence a firm's readiness for exploiting existing and new technologies: dynamic marketing capabilities (understanding of market rhythm and marketing flexibility), dynamic research and development capabilities (its flexible and programmatic R&D capabilities), flexible manufacturing capabilities (manufacturing competencies) and flexible financial capabilities. As compared with Wang and Ahmed's (2007) components of DCs, dynamic marketing capabilities can be identified under adaptive capability, dynamic research and development capabilities can be associated with absorptive capability, and flexible manufacturing capabilities can be related to innovative capability and flexible financial capabilities can be important for all three DCs components in general.

In addition, Zahra, Filatotchev and Wright (2009) suggest that absorptive capability fuels corporate entrepreneurial activities. Furthermore, Verona and Ravasi (2003) conclude that firms must build DCs that allow creation, absorption and integration of knowledge which involves exploration and exploitation and therefore, firms must build DCs to sustain product innovation. Easterby-Smith and Prieto (2008) develop a model that identifies a

link between DCs and knowledge management that is moderated by exploration and exploitation. The model shows a mutual interaction between learning processes, DCs and knowledge management. Easterby-Smith and Prieto (2008) also encourage studying the relationship between DCs and exploratory and exploitative capabilities.

Thus, literature indicates the role of DCs as a potential antecedent of exploratory capabilities and exploitative capabilities (O'Reilly and Tushman, 2008) and that needs further empirical investigation. Therefore, this study attempts to provide more empirical evidence related to the nature of the relationship between DCs and exploratory capabilities and exploitative capabilities. He and Wong (2004) claim that exploration versus exploitation should be used with reference to a firm itself and its existing capabilities, resources and processes, and not relating to a competitor or at the industry level. Their observation also reiterates the value of studying the effect of a firm's DCs on exploratory capabilities and exploitative capabilities taking an inside-out approach. Hence, the above conceptual and empirical evidence support the view that DCs of firms can be a positive antecedent of their exploratory capabilities and exploitative capabilities. Therefore, it is hypothesised that:

H_3: Dynamic capabilities have a positive relationship with exploratory capabilities of firms.

H_4: Dynamic capabilities have a positive relationship with exploitative capabilities of firms.

Structural ambidexterity suggests structural mechanisms such as separate subdivisions, each focusing on either exploration or exploitation and coordinated by the top management, that enable firms to simultaneously develop and apply exploratory capabilities and exploitative capabilities (e.g. Adler et al., 1999; Benner and Tushman, 2003; Jansen et al., 2008; Smith and Tushman, 2005). Instead of traditional structural ambidexterity, Gibson and Birikinshaw (2004) present the idea of contextual ambidexterity which is focused on both alignment, i.e. coherence among all the patterns of activities in the business unit and they are working together toward the same goals, and adaptability, i.e. the capacity to reconfigure activities in the business unit quickly to meet changing demands in the task environment. Under this approach, exploitation-oriented actions are geared toward alignment and exploration-oriented actions are geared toward adaptability

(Gibson and Birikinshaw, 2004). As far as SMEs are concerned, Lubtakin et al. (2006) reckon that due to lack of resources and the nature of administrative systems, SMEs may find it difficult to manage contradictory processes of exploration and exploitation. However, as argued by Gibson and Birikinshaw (2004), without creating dual structures, a firm can create a context which helps achieve contextual ambidexterity. Thus, Lubtakin et al. (2006) claim that SMEs have to rely on their top management team to reach ambidexterity and they empirically established that the behavioural integration of the top management team has a positive influence on achieving ambidexterity in SMEs and, at the same time, ambidexterity between exploration and exploitation affects firm performance. Such behavioural integration is "intended to capture the level of the senior team's wholeness and unity of effort" (Lubtakin et al., 2006: 647).

Furthermore, March (1991) points out the danger of going to an extreme in exploration or exploitation referring to the short-term and long-term effects on firm performance. Auh and Menguc (2005) claim that exploration challenges existing ideas with innovative and entrepreneurial concepts, whereas exploitation helps a firm to secure a comfortable position in the marketplace by committing firm's resources to ensure the current viability of the firm against its competitors. However, the proposed trade-off between exploration and exploitation (March, 1991) was not supported in Greve's (2007) empirical study that reveals that reductions in organisational performance increase the rate of making both exploration innovations as well as exploitation innovations at the same time. Moreover, Zollo and Winter (2002) argue that exploration leads to exploitation and could feed back into a new exploration phase and they suggest that in addition to famous trade-off between exploration and exploitation, there can be a co-evolutionary relationship between the two types of entrepreneurial capabilities. Empirical evidence reveals that the interaction between exploration and exploitation is positively related to firm performance, e.g. sales growth rate (He and Wong, 2004), which highlights the importance of balancing exploration and exploitation (Ireland and Webb, 2007). Therefore, building upon the above conceptual and empirical evidence and considering the importance given to the ambidexterity between exploratory capabilities and exploitative capabilities of firms that came to light in the above discussion, it is also hypothesised that:

H_5: Exploratory capabilities and exploitative capabilities of firms are positively correlated.

3.3.2. Entrepreneurial Capabilities and Firm Performance

Firm performance has been widely researched and discussed in the strategic management and entrepreneurship literatures. It has been identified as an important concept in strategic management specially in building theories of strategy (Venkatraman and Ramanujam, 1986). However, numerous concerns have been raised with regard to the ambiguity of the meaning of the concept and validity of available measures.

Hult et al. (2004:430-431) define business performance as "the achievement of organizational goals related to profitability and growth in sales and markets share, as well as the accomplishment of general firm strategic objectives". This is reflected by the extent firm's financial and other objectives are achieved through adopting marketing strategies and other strategies (Knight, 2000). As far as the SMEs are concerned, they typically start-up ventures with several objectives that are mainly financial: market share, sales growth, profit and similar factors, and the firm's performance can be measured by the degree of achievement of those objectives (Cavusgil and Zou, 1994; Knight, 2000). However, due to lack of information and guidance on performance measurement in the field of entrepreneurship (Brush and Vanderwerf, 1992; Chandler and Jansen, 1992), what is defined as successful performance for new ventures and the measure of their performance vary widely (Murphy, Trailer and Hill, 1996). A study that addressed this gap revealed that the measures of performance were mainly focused on 'efficiency', for example, quick ratio, current ratio; 'profitability', for example, Return on Equity (ROE), Return on Investment (ROI), Earning Per Share (EPS), net income; and 'growth', for example, number of employees, sale (Murphy, Trailer and Hill, 1996). The use of multiple dimensions of performance is recommend by Murphy, Trailer and Hill (1996), particularly to address control variables such as size, industry, age and risk, that are mostly relevant to new ventures and small businesses.

'Success or failure' has been a popular performance measure in studies on the relationship between strategic management practices and organisational performance in small firms (Chambers and Gold, 1963; Trow, 1961). However, 'success or failure' does little justice to the small firm moving toward success and also wide use of this measure offers evidence of the difficulty in obtaining objective measures within small firms (Des and Robinson,1984). In order to avoid such weaknesses, as recommended by Murphy, Trailer, and Hill (1996), performance can be measured in terms of different dimensions.

Venkatraman and Ramanujam (1986) measure firm performance along two dimensions: financial performance and operational performance where financial performance is typically measured using indicators such as sales growth, profitability (reflected by ratios such as return on investment, return on sale and return on equity), earnings per share, and on the other hand, measures such as market-share, new product introduction, product quality, marketing effectiveness, manufacturing value-added and other measures of technological efficiency within the domain of business performance are used to measure operational performance. Researchers have followed Venkatraman and Ramanujam (1986) in measuring firm performance (e.g. Panigyrakis and Theodoridids, 2007; Rue and Ibrahim, 1998). Rue and Ibrahim (1998) followed Venkatraman and Ramanujam's (1986) dimensions (i.e. financial and operational) in measuring small business performance. However, the problem of obtaining objective data within small firms (Des and Robinson, 1984) might reduce the applicability of performance indicators such as profitability, earning per share, market share etc suggested by Venkatraman and Ramanujam (1986), in the high-tech SMEs setting.

Measures of performance can be identified as 'subjective measures' and 'objective measures' (Des and Robinson, 1984; Jaworski and Kohli, 1993). Calantone, Cavusgil and Zaho (2002) measured firm performance using return on investment, return on assets, return on sales and overall profitability. They claim the first three as more objective and the overall profitability as more subjective measure. Lumpkin and Des (2006) assessed firm performance using subjective measures where they obtained individual responses to three performance indices, i.e. market share, profitability and return on investment, and overall company performance, measured on a 7-point Likert-type scale ranging from 1 = "low performer" to 7 = "high performer" as compared with their competitors; the respondents were asked to assess their organisation's performance over the past five years relative to the competitors. Adapting Knight (2000), in this study, firm performance of high-tech SMEs is defined as the extent to which the firm's financial and nonfinancial objectives are achieved through execution of the firm's strategies. Due to the nature of the research setting and difficulties in obtaining objective data, this study uses subjective measures of performance. Enhancing validity and reliability of subjective measures, prior research recommends that subjective measures of performance are consistent with objective measures (Dess and Robinson, 1984; Dess, Lumpkin and Covin, 1997; Knight,

2000; Slater and Narver, 1994; Venkatraman and Ramanujam, 1986). Selected research on SMEs related firm performance is presented in Table 3.4.

Table 3.4. Selected Research on SME Firm Performance

Author/s and the Year	Type/Approach	Definition of Firm Performance	Key Findings/Contribution
Murphy, Trailer and Hill (1996)	Empirical: Qualitative and quantitative (Reviewing 51 published entrepreneurship studies and a sample of 995 firms and another sample of 586 firms)	No original definition.	The findings of the study suggest that the generalisation of empirical findings across performance variables is not justified. "Performance" fails to meet the requirements of convergent and discriminant validity necessary to validate a unidimensional construct. Clearly, distinct dimensions of performance exist. Because there are multiple dimensions of what referred to as performance, the use of the generic term "firm performance" is actually quite ambiguous. Single measures of performance suffer from uncertainty associated with equifinality. The selection of a given performance dimension or measure should be explained and justified. Studies should include multiple dimensions of performance. Future studies must address some of the critical control variables such as size, industry, age and risk that are particularly relevant to new ventures and small businesses.
Knight (2000)	Empirical: Quantitative (268 manufacturing SMEs)	Performance reflects the extent to which the firm's financial and other objectives are achieved through execution of tactics and marketing strategies. Small and medium-sized enterprises typically initiate ventures with several objectives, the most important of which are financial-that is, related to market share, sales growth, profit, and similar factors (Knight, 2000:17).	Entrepreneurial orientation is associated with the development of a quality leadership; globalisation response is positively associated with corporate performance; and internationalisation preparation, the commitment of appropriate resources to entering foreign markets, and the adaptation, are positively associated with firm performance. In general, SMEs strongly affected by globalisation tend to put greater emphasis on acquiring technology, on responding to globalisation, and on preparing in advance before entering foreign markets. Managers appear to regard these as important tactics in dealing with the forces of globalisation.
Baum, Calabrese and Silverman (2000)	Empirical: Quantitative (369 observations of Canadian biotech start-ups)	No original definition.	Findings show how variation in the alliance networks start-ups configure at the time of their founding produces significant differences in their early performance, contributing directly to an explanation of how and why firm age and size affect firm performance.
Watson and Robinson (2003)	Quantitative (Initial survey of 8375 and a subsample 2367 Australian SMEs)	No original definition.	Although profits are significantly higher for male-controlled SMEs, so is the variation in profits (risk), after adjusting for risk, it was found that there was no significant difference between the performances of male- and female-controlled SMEs.
Sawyerr, McGee and Peterson (2003)	Empirical: Quantitative (Owner-managers from 153 small firms in the high technology sector)	No original definition.	As the level of perceived uncertainty in the environment increased, so did the frequency of internal networking. Increased internal networking in response to increased perceived uncertainty resulted in better firm performance. The data did not support for the predictions related to external networking and firm performance.

Wiklund and Shepherd (2003)	Empirical: Quantitative (384 Swedish small and medium-sized businesses)	No original definition.	Knowledge-based resources (applicable to discovery and exploitation of opportunities) are positively related to firm performance and that entrepreneurial orientation enhances this relationship.
He and Wong (2004)	Empirical: Quantitative (206 manufacturing firms in Singapore and Malaysia)	No original definition.	(1) the interaction between explorative and exploitative innovation strategies is positively related to sales growth rate, and (2) the relative imbalance between explorative and exploitative innovation strategies is negatively related to sales growth rate.
Wiklund and Shepherd (2005)	Empirical: Quantitative (A longitudinal design 413 Swedish firms)	No original definition.	Entrepreneurial orientation and access to financial capital both have a statistically significant positive relationship with small business performance. At low levels of EO, firms with a dynamic environment and considerable access to financial capital are relatively high performers. Those in a stable environment with little access to financial capital are the worst performers.
Morris et al.(2006)	Empirical: Quantitative and qualitative (103 surveys and 50 interviews with female entrepreneurs)	No original definition.	Growth orientation was associated with whether a woman was "pushed" or "pulled" into entrepreneurship, was motivated by wealth or achievement factors, had a strong women's identity in the venture, had equity partners, and believed women faced unique selling obstacles. Modest and high growth entrepreneurs differ in how they view themselves, their families, their ventures, and the larger environment. Growth is a deliberate choice and that women have a clear sense of the costs and benefits of growth and make careful trade-off decisions.
Watson (2007)	Empirical: Quantitative (5014 Australian SMEs)	No original definition.	There was a significant positive relationship between networking (particularly with formal networks such as external accountants) and both firm survival and, to a lesser extent, growth, but not ROE. Furthermore, network intensity is found to be associated with survival, and network range with growth.
Li, Huang and Tsai (2009)	Empirical: Quantitative (165 new ventures in Taiwan)	No original definition.	The direct effect of entrepreneurial orientation on firm performance is reduced with the indirect effect of entrepreneurial orientation through knowledge creation process. Consequently, entrepreneurial orientation is positively related to firm performance, and knowledge creation process plays a mediating role in this relationship.
Terziovski (2010)	Empirical: Quantitative (600 Australian SMEs)	No original definition.	SMEs' performance tends to improve depending on the extent they follow large manufacturing firms with respect to formal strategy and structure, and the extent they recognise that innovation culture and strategy are closely aligned throughout the innovation process.

DCs within the RBV are identified as a firm's capabilities in integrating, building, and reconfiguring its resources (Eisenhardt and Martin, 2000; Teece, Pisano and Schuen, 1997). As hypothesised above, developing and applying such capabilities could boost a

firm's entrepreneurial capabilities. The ultimate goal of developing and applying entrepreneurial capabilities is to achieve superior firm performance by gaining the competitive advantage. Hult et al. (2004) found that the level of innovativeness positively influence the level of business performance. Based on the RBV, Hult et al. (2004) describe how firms can gain competitive advantages by deploying resources in coming up with new products, processes etc. In addition, knowledge-based resources that are applicable to exploration and exploitation of opportunities have a positive influence on firm performance (Wiklund and Shepherd, 2003).

Extant literature provides evidence to support possible effects of exploratory capabilities and exploitative capabilities on firm performance. Uotila et al. (2009) report a curvilinear relationship between the relative amount of exploration and firm financial performance. Lubatkin et al. (2006) empirically establish that both exploration and exploitation orientations contribute uniquely to overall firm performance of SMEs. The highest levels of subsequent performance is reported from the most ambidextrous firms, i.e. the firms who equally pursue exploration and exploitation, who had the most behaviourally integrated top management team (Lubatkin et al., 2006). However, the researchers point out the importance of identifying the effects of both the capabilities on firm performance as they could have fundamentally different influences on firm performance (e.g. March, 1991; He and Wong, 2004). Therefore, it is hypothesised that:

H_6: Exploratory capabilities are positively related to firm performance.
H_7: Exploitative capabilities are positively related to firm performance.

3.4. The Research Model

The research model presents the tentative relationships among key constructs under consideration of this study (Figure 3.2). Preceding discussion of the elements of the research model leads to a set of hypotheses that are derived from the conceptual and empirical evidence found in the extant literature. As presented in the model, the development of DCs of a firm may be influenced by the success trap (Ahuja and Lampert, 2001; Levinthal and March, 1993; Levitt and March, 1988) and the market dynamism (Eisenhardt and Martin, 2000; March, 1991; Zahra, Sapienza and Davidson, 2006). More importantly the model examines the relationship between DCs of a firm and its

entrepreneurial capabilities that include exploratory capabilities and exploitative capabilities (Alvarez and Busenitz, 2001; Atuahene-Gima, 2005; Auh and Menguc, 2005; March, 1991; Quintana-Garcia and Benavides-Velasco, 2008; Shane and Venkataraman, 2000; Yalcinkaya, Calantone and Griffith, 2007) and the relationship between the two constructs of exploratory capabilities and exploitative capabilities (Auh and Menguc, 2005; He and Wong, 2004; March, 1991; Greve, 2007; Ireland and Webb, 2007; O'Reilly and Tushman, 2008; Zollo and Winter, 2002). The model is further extended to examine the influence of those entrepreneurial capabilities on firm performance (Henderson and Clerk, 1990; Özsomer and Gençtuŕk, 2003).

3.5. Summary

Drawing on the conceptual and empirical work found in the literature, this chapter presented the research model that indicates tentative relationships among the success trap, market dynamism, DCs, exploratory capabilities, exploitative capabilities and firm performance. A set of hypotheses were formulated based on the research model.

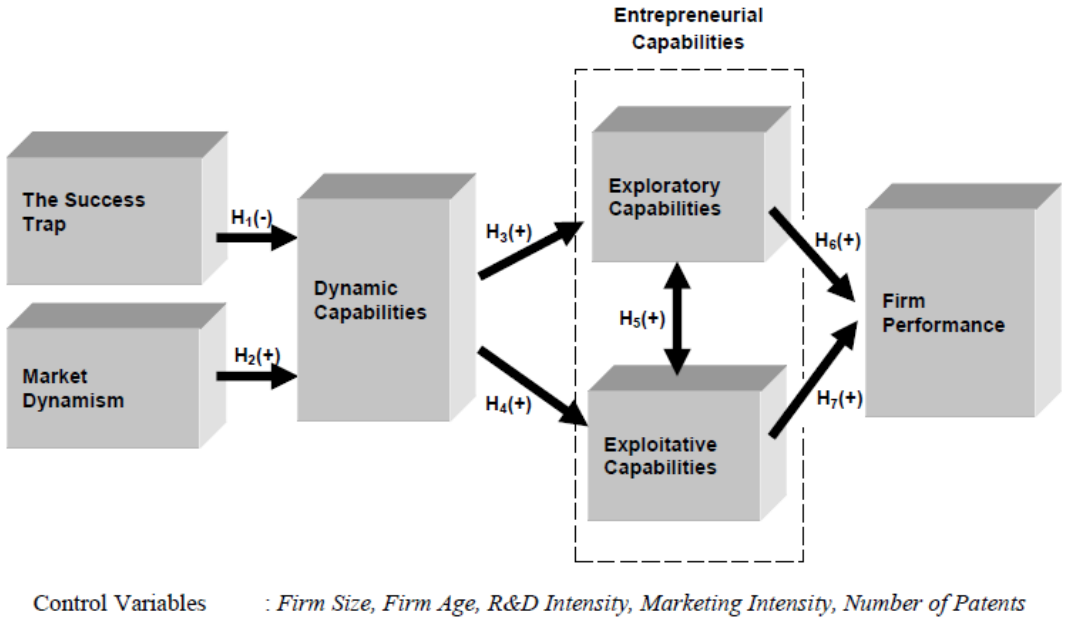


Figure 3.2. The Research Model

Chapter 4: Research Methodology

4.1. Introduction

This chapter presents the research methodology and research methods used in this study in achieving the research objectives presented in Chapter 1. The chapter distinguishes the research methodology of the study from its research methods (Blaikie, 1993) whilst fitting the research methods to a predetermined methodology (Guba and Lincoln, 1994). Thus, largely within a positivist paradigm, the study takes a methodological approach of hypothesis testing, an ontological stance that is aimed at understanding the true state of affairs, and also an epistemological stance that assumes that the objects being investigated are independent of the researcher (Guba and Lincoln, 1994). Based on the above philosophical approach, the study employs the quantitative method of mail survey as the main research method. In addition, as a complementary method, the study also adopts qualitative semi-structured interview method to explore the results of the quantitative stage. Thus, the study can be identified as a two- stage study that involves quantitative and qualitative methods.

This chapter is structured as follows: the research philosophy; the research approach, research setting, research design, quantitative data collection and analysis, qualitative data collection and analysis, triangulation, common method variance, preliminary results and data screening, and the profile of the respondent firms.

4.2. Research Philosophy

Multiple research philosophies or paradigms have been discussed in the literature. "Research philosophy relates to the development of knowledge and the nature of that knowledge" (Saunders, Lewis and Thornhill, 2007:101) whereas a research paradigm is viewed as "a set of *basic beliefs* (or metaphysics) that deals with ultimates or first principles" (Guba and Lincoln, 1994:107). The ontological and epistemological stances of the study are identified based on Guba and Lincoln's (1994) categorisation of alternative inquiry paradigms: positivism, post-positivism, critical theory and constructivism. As described by Guba and Lincoln (1994), the paradigm of a research can be determined by looking at the responses to ontological, epistemological and methodological questions. The ontological question deals with "the form and nature of reality and, therefore, what is there

that can be known about it" (Guba and Lincoln, 1994:108); it is "the science or study of being" (Blaikie, 1993). On the other hand, the epistemological question refers to "the nature of the relationship between the knower or would-be-knower and what can be known" (Guba and Lincoln, 1994:108). Epistemology deals with "the theory or science of the method or grounds of knowledge" (Blaikie (1993:18) and it helps understand the best ways of enquiring into the nature of the world (Easterby-Smith, Thorpe and Jackson, 2008). Table 4.1 presents an overview of Guba and Lincoln's (1994) inquiry paradigms. The methodological stance and methods are discussed in a subsequent section of the chapter.

Table 4.1. An Overview of Inquiry Paradigms

Item	***Positivism***	***Postpositivism***	***Critical Theory***	***Constructivism***
Ontology	*Reflected by naive realism that believes that there is an apprehendable reality;* *Time-and context free generalisations can be made in summarising the knowledge of the way things are.*	*Critical realism which assumes that there is an imperfectly apprendable reality.*	*Based on historical realism which assumes that reality has been shaped by social, political, cultural, economic, ethnic, and gender factors and crystallised into structures that are taken as real, a virtual or historical reality.*	*The realities are constructed by individuals and those constructions are not true in absolute sense and they are alterable.*
Epistemology	*The investigator and the investigated object are independent.*	*The dualist assumption, i.e. the assumption that the investigator and the investigated are independent, is abandoned but objectivity remains a regulatory ideal.*	*It is assumed that the investigator and the investigated are interactively linked, making the findings mediated by the values of the investigator.*	*The investigator and the investigated are so closely linked and the findings are created as the investigation proceeds: the distinction between ontology and epistemology disappears.*

Source: Adapted from Guba and Lincoln (1994)

According to Guba and Lincoln's (1994) categorisation, it is clear that the ontological stance of the present study falls under the positivist paradigm where the study leads to time and context free generalisations via hypotheses testing that helps in understanding the way things are. Within the positivist paradigm, it also takes an epistemological stance where the investigator and the investigated object are assumed to be independent. Thus, based on a positivist paradigm, taking them as an observable social reality (Remenyi et al., 2002), this study observes the UK high-tech industries. In doing so, empirical evidence is collected to expand the knowledge in the RBV and the DCs perspective, especially focusing on identifying the commonalities of DCs across firms and also on recognising the antecedents and consequences of DCs and entrepreneurial capabilities. The study mainly employs a quantitative approach.

The study also adopts the qualitative semi-structured interview method, as a complementary method, to explore the results of the quantitative stage. The study uses qualitative data to identify the firm-specific routines within the identified commonalities of DCs and to explain the results of hypothesis testing. The firm-specific routines of DCs of the sample firms are identified adopting a theory-driven thematic coding process that takes more of a deductive approach; this study is aimed at testing hypotheses within a positivist paradigm rather than building theories. However, it should be noted here that apart from analysing data based on existing themes, the study allows new themes to emerge during the process of qualitative data analysis.

4.3. The Research Approach

Research approach indicates how the theory and empirical research can be interrelated (Bryman and Bell, 2003). Two main research approaches can be found in the literature: deductive and inductive (Saunders, Lewis and Thornhill, 2007). Deductive approach involves testing a theory in the form of hypothesis testing whereas the inductive approach is concerned with building a theory (Hyde, 2000). This study mainly adopts a deductive approach which involves testing a set of hypotheses developed based on the RBV and the DCs perspective.

4.4. Research Setting

This study is set within the UK high-tech industries and this section briefly describes the importance of high-tech SMEs as indicated by its role in the UK economy and by the policy decisions of the UK government regarding SMEs and high-tech industries. The section also identifies the capability gap in high-tech SMEs in light of available research findings.

There is no generally accepted definition for high-tech industries or high-tech firms found in the literature. In defining high-tech firms, Butchart (1987) looked at R&D intensity, proportion of scientists, professional engineers and technicians working for firms to classify some industries as high-tech industries. Jones-Evans and Westhead (1996) followed Butchart's (1987) definition in their review of the high technology sector in the UK. In addition, Crick and Spence (2005:168) define high-tech SMEs as firms which are "small and medium-sized firms with advanced knowledge and capabilities in technology,

an educated workforce, and the ability to adapt quickly to fast changing environments". This definition highlights the important role played by knowledge and capabilities in high-tech firms.

However, according to the European Commission (2011), 'high-tech' can be defined taking three approaches: sector, product or patent. The OECD classification of high-tech industries that has been widely accepted is based on the sector approach. This classification uses both direct and indirect R&D intensity that reflects 'technology-producer' or 'technology-user' aspects (OECD, 2003). In assessing the direct and indirect R&D intensity, the direct R&D was measured based on direct R&D expenditure whereas indirect R&D was calculated taking the (expenditure on) technology embodied in intermediates and capital goods purchased (Hatzichronoglou, 1997). Thus, the OECD defines industries with more than 4% R&D intensity and who are knowledge-intensive, as high-tech industries (Smith, 2000). In studying the UK high-tech SMEs, the present study adopts the OECD (2003) Scoreboard 2003 classification that defines five high-tech industries under distinct Standard Industry Classification (SIC) codes: aircraft and spacecraft (SIC 353), pharmaceuticals (SIC 2423), office and computing machinery (SIC 30), radio, TV and communication equipment (SIC 32) and medical, precision and optical instruments (SIC 33).

Among other reasons, the main reason for drawing a sample of high-tech firms is their promising nature and the potential contribution they can make in the economic development of a nation. It has been evident that, high-tech industries play an important role in the UK economy. As presented in the Bank of England's Quarterly Bulletin 2006 Q3 (Bank of England, 2006), out of the above five industries, medical and pharmaceutical, office machinery and computers, and radio, TV and communications were the only three industries among twelve UK industries that increased their export market share between 1991-2001. As pointed out by Mason, Bishop and Robinson (2009), high-tech firms are in the high growth category of UK firms. Furthermore, in the UK, 62.5% of share of business R&D in the manufacturing sector comes from the high-tech industries, which is the fifth largest percentage among the OECD countries (OECD, 2007).

The importance of UK high-tech industries is further evident by the calls for policy decisions to protect and boost those industries. For example, National Endowment for

Science, Technology and the Arts (NESTA), an independent endowment in the UK, has asked for the government support to protect UK small high-tech firms. NESTA warns that without the government support for those industries, UK could lose its global standing in areas such as healthcare and biotechnology (BBC, 2009, April 20). The UK government has taken important policy initiatives to develop high-tech industries. According to the Science & Innovation Investment Framework (SIIF) 2004-2014 (HM Treasury, 2004), developing capabilities in innovating and commercialising those innovations of the UK firms is a priority. In line with SIIF, the Prime Minister (2007-2010) announced that £200m from the UK Innovation Investment Fund (UKIIF) will be used to benefit life sciences, digital and advanced manufacturing businesses (Department for Business Innovation and Skills-BIS, 2010b).

In addition to policymakers, researchers also have identified capability gaps in industries in general and in high tech SMEs in particular, and have stressed the importance of enhancing innovations in those industries. For example, in the United States (US) business context, Stevenson and Gumpert (1985) wrote "If only our nation's business-large and small- could become more entrepreneurial, the thinking goes, we would improve our productivity and compete more effectively in the world marketplace". The same would apply to the UK high-tech firms in today's context. In the European context, Delmas (2002) found that the difficulty in developing DCs is one of the main reasons for the lack of innovation in European firms. Zahra, Sapienza and Davidson (2006) point out that, overall, the literature lacks DCs research in the context of SMEs. In the study by Romijn and Albaladejo (2002) on the innovation capability of small high-tech firms in the Southeast region of the UK, it was found that prior experience of the staff in science and engineering is significantly related to the innovative performance of those firms. It seems that Romijn and Albaladejo (2002) study was focused only on innovative capabilities of the firms and this calls for studies that focus on DCs of high-tech SMEs with a wider focus on their innovative, adaptive and absorptive capabilities (Wang and Ahmed, 2007).

Thus, the above policy initiatives and research findings highlight the need for research on firm-level entrepreneurial capabilities in UK high-tech industries. This study is aimed at filling the above gap and contributing toward developing entrepreneurial capabilities in the UK high-tech industries. Specifically, the study is focused on identifying the influence of DCs on entrepreneurial capabilities of UK high-tech SMEs. More importantly, identifying

the level of entrepreneurial capabilities of UK high-tech industries in the current economic condition would provide important implications for researchers, managers and policy makers.

4.5. Research Design

Research design is the "the blueprint for the collection, measurement, and analysis of data" (Philips, 1971:93) and it ensures that the researcher obtains the relevant evidence to research question, and the evidence needed to collect determines sampling strategy and methods of data collection (Blumberg, Cooper and Schindler, 2008; De Vaus, 2001). De Vaus (2002:30) describes the unit of analysis as "the unit about which we obtain information: it is the unit whose characteristics we describe". As this study is mainly focused on understanding the firm-level entrepreneurial capabilities and how DCs of a firm influence those entrepreneurial capabilities, 'firm' was taken as the unit of analysis of the study. Following Huber and Power's (1985) guidelines on how to obtain quality data, strategic level managers, one manager representing each firm, were selected as key informants in the study. The limitations of single informants are briefly discussed in the section on common method variance.

Distinguishing between research design and research methods, De Vaus (2001) claims that research design is the logical structure of the inquiry and how data are collected is irrelevant to the logic of the design. De Vaus (2001) defines four types of research design: experiment, case study, longitudinal design and cross-sectional design. Data collection methods of questionnaire survey, interview (structured or loosely structured), observation, analysis of documents and unobtrusive methods can be used under any of the above research design types. This study adopts a cross-sectional research design and, as mentioned earlier, collects data mainly employing survey method within the positivist paradigm that is complemented by semi-structured interview method. Thus, taking positivist paradigm as the main paradigm, the study follows a deductive approach of hypothesis testing. The cross-sectional design allows the collection of data on many cases at a single point in time where a set of quantitative and quantifiable data on many variables can be collected to examine patterns of association (Bryman and Bell, 2003). Figure 4.1 gives an overview of the process of the study.

As far as the context of this study is concerned, the need for multiple methods in RBV research has been stressed in the extant literature. Hoskisson et al. (1999), claim that the RBV requires multiplicity of methods to study firm resources, and integration of quantitative and qualitative methodological tools such as quantitative questionnaires and qualitative interviews (e.g. Henderson and Cockburn, 1994) would be very effective with the emphasis of inside-out approach of the RBV. Katila and Ahuja (2002) examined search scope (exploration) and search depth (exploitation) largely through archival patent data. They identified problem-solving or *search* as a DC of a firm and their study established that problem-solving capabilities can be an important source of resource heterogeneity (Katila and Ahuja, 2002). To overcome this limitation of archival research, Katila and Ahuja (2002) point out the need for future research using complementary approaches such as surveys and case studies to measure search scope and search depth. As mentioned earlier, identifying DCs as an aggregate multidimensional construct, Barreto (2010) recommends the use of multiple research methods, for example, survey method and case study method, in assessing DCs. Based on the recommendation by Hoskisson et al. (1999) and past researchers, filling a methodological gap in the RBV and DCs research, this study adopted a two-stage research design where survey method was used as the main method. The choice of research methods was in line with the objectives of this study.

In addressing one of the main objectives of the study, i.e. test the hypothesised effects of the antecedents and the consequences of DCs and entrepreneurial capabilities, the survey method was used. As recommended by Bryman and Bell (2003), survey method helps examine patterns of association among the constructs of the study, i.e. the success trap, market dynamism, DCs, entrepreneurial capabilities and firm performance whilst controlling selected variables. Moreover, the use of survey method helped to understand the commonalities of DCs across firms, which is also a main objective of the study. Overall, survey method contributes to generalisability of the findings of this study (Jick, 1979).

The main quantitative method of questionnaire survey was supplemented by the qualitative method of semi-structured interviews that were aimed at collecting qualitative data to get deeper insights, particularly, into the DCs construct and the relationships among other key constructs of the study.

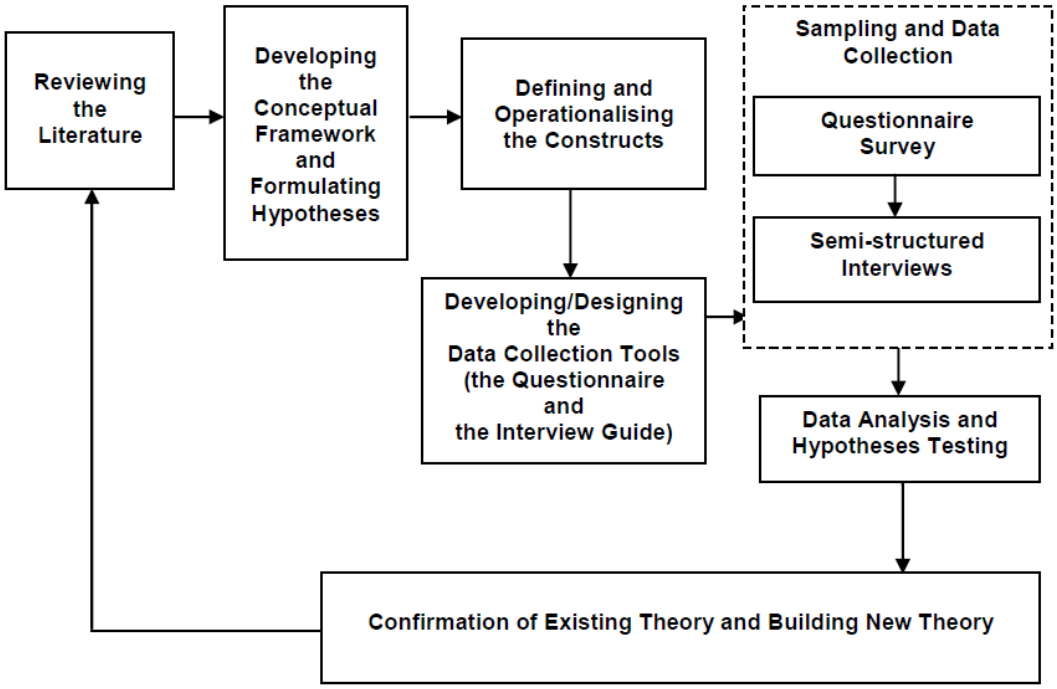


Figure 4.1. The Research Process

4.6. Quantitative Data Collection and Analysis

This study mainly adopted hypotheses testing approach as it was clear what is to be investigated and as it made information collection speedy and efficient (Easterby-Smith, Thorpe and Lowe, 2004). However, the same approach could lead to trivial findings as it is more or less confirmation of what is already known (Easterby-Smith, Thorpe and Lowe, 2004). In order to minimise this disadvantage and to make the findings stronger, and also to have better explanations and more insights, semi-structured qualitative interviews were subsequently conducted to explain the quantitative results.

The quantitative stage involved survey method, the main method of data collection in the study, which is widely used in deductive research. Saunders, Lewis and Thornhill (2007) identify many advantages of the survey method: It allows collecting large amount of data mainly by administering a questionnaire from a sizeable population, it is more economical, survey data is easy to explain and understand and also to analyse quantitatively, and such data can be used to investigate possible relationships between variables. The survey method fitted well with the requirements of this study as it was aimed at measuring relevant constructs and identifying the relationships among them.

A mail survey was conducted using a self-administered questionnaire. Saunders, Lewis and Thornhill (2007) classify types of questionnaire into two broad categories: (1) self-administered questionnaires (internet-mediated questionnaire, postal/mail questionnaire, and delivery and collection questionnaire) and (2) interviewer-administered questionnaires (telephone questionnaire and structured interview). Self-administered questionnaire surveys give access to a larger sample of respondents at a minimum cost (Bryman and Bell, 2003; Saunders, Lewis and Thornhill, 2007). In addition to being free from influence by the researcher, in such surveys, respondents can decide when to complete the survey and how long they should take, and they also can maintain anonymity (Blumberg, Cooper and Schindler, 2008; Bryman and Bell, 2003; Fowler, 2002). Moreover, self-administered questionnaire surveys encourage the respondents to give genuine answers that reduce social desirability (Bryman and Bell, 2003; Dillman, 2000). However, receiving incomplete responses, researcher's limited choice over the types of and the number of questions, limited control over perceptual process of respondents that could lead to misinterpretation of questions, and lack of opportunity for further enquiries of the responses have been identified as limitations of self-administered questionnaire surveys (Bryman and Bell, 2003; Hoinville and Jowell, 1978; Jenkins and Dillman, 1997; Neuman, 2003). Therefore, considering the difficulties in using interviewer-administered questionnaires, internet-mediated questionnaires, and delivery and collection questionnaires due to lack of information (e.g. e-mail addresses of intended respondents), time and other resource constraints, and also the advantages of self-administered questionnaires, a mail survey was conducted using a self-administered questionnaire in this study.

4.6.1. Sampling of the Survey

Sampling plays a key role in this study as it is aimed at generalising the findings across high-tech SMEs. The level of representativeness of a sample depends on the sampling strategy. A researcher can estimate relationships in a population at a fraction of the cost of assessing the entire population (Short et al., 2002). A population refers to "a collection of elements about which we wish to make an inference" (Scheaffer, Mendenhall and Ott, 1996:42) and a sample is "a subset or a segment of population that is selected for investigation" (Bryman and Bell, 2003:93).

As mentioned above, based on the OECD (2003) classification of high-tech industries, five industries were included in identifying the population of the study. The Experian Database that compiles detailed information of nearly 2.79 million business firms in the UK including England, Scotland, Wales and Northern Ireland, was used in selecting the sample for the study, and the majority of the data held within the Experian Database comes from Companies House, Yellow Pages and Thomson Directory data (Experian, 2009). Since the Experian Database was using UK Standard Industry Classification 2003 (UK SIC 2003) at the time of retrieving data, the high-tech SMEs in each industry were identified based on UK SIC 2003: Aircraft and spacecraft (SIC 353), pharmaceuticals (SIC 2423), office and computing machinery (SIC 30), radio, TV and communication equipment (SIC 32) and medical, precision and optical instruments (SIC 33).

All the sub-categories of high-tech firms under UK SIC 2003 were checked against the UK SIC 2007 sub-categories using the Companies House (UK) conversion table (Appendix 1). This would make sure that all the high-tech SMEs (defined under UK SIC 2003 or UK SIC 2007) that were available on the Experian Database were included in the sample. Following the European Commission's new SME definition (2005), a firm with 10 or more but less than 50 employees was considered as a small firm and a firm with 50 or more but less than 250 employees was considered as a medium sized firm. The micro firms, i.e. those with less than 10 employees, were excluded from the sample as the small and medium-sized firms can be in a different league as far as the means to invest in systems and technology are concerned (Laforet, 2008). Moreover, high-tech firms who were less than 3 years old were excluded from the sample of 1211 firms. As it has been reported by He and Wong (2004), average project duration can be more than three years from innovation idea to full implementation. This indicates that a firm should have been in operation for a minimum of three years for its performance to be assessed. Thus, out of the above 2.79 million firms, a population of 1211 UK firms across the five high-tech industries that employed 10-249 employees were identified.

It is widely recognised that UK SME studies often have to use old and incomplete datasets due to the difficulty of setting up to date and complete datasets (e.g. Department for Business, Enterprise and Regulatory Reform- BERR, 2008a). Therefore, since there was no single source that clearly defines the size of the population of UK high-tech SMEs, all 1211 high-tech SMEs available on the Experian database that met the requirements of the

study were included in the sample for the survey making it more representative. This was important as most common multivariate statistical techniques used in strategic management "are based on the statistical inference of a population's value or relationships among variables from a randomly drawn sample of that population" (Hair et al., 1998:10). Table 4.2 presents the UK high-tech industry categories and the number of firms that were included in the sample representing each industry. Each industry category represents between 14% and 29% of the total sample.

Table 4.2. Composition of the Sample of the Survey

High-Tech Industry Type	Number of Firms	%
Aerospace	168	14%
Pharmaceutical and Biotechnology	166	14%
Office and Computing	355	29%
Radio, TV, and Communication	245	20%
Medical and Optical Equipment	277	23%
TOTAL	1211	100%

4.6.2. Operationalising the Key Constructs: Specifying the Domain of Constructs and Generating Items

Following Churchill's (1979) guidelines for developing measures, a questionnaire was developed and tested. Items were generated for each construct following these steps (Churchill, 1979): specifying the domain of constructs and generating items for each construct; questionnaire design and purifying the measures.

A construct is an abstract entity (Diamontopoulos, 2005) and it reflects a theoretical interest in a phenomenon (Edwards and Bagozzi, 2000). In specifying the domain of constructs, the researcher must clearly identify what is included in the definition and what is excluded (Churchill, 1979). The key constructs in this study are the success trap, market dynamism, dynamic capabilities, exploratory capabilities and exploitative capabilities and firm performance. The seminal works discussed and summarised in previous chapters help define those constructs.

The emphasis of item generation is to "develop a set of items which tap each of the dimensions of the construct at issue" (Churchill, 1979:68). In the process of generating items to measure the key constructs, an extensive review of literature was carried out to identify possible measures already available. As far as market dynamism, DCs, exploratory

capability, exploitative capability and firm performance are concerned, existing items were used with or without adaptations. For the success trap, a new set of items were developed based on the conceptual work available in the literature. All the items were rated on a seven-point scale (i.e. from 1= "strongly agree" to 7 = "strongly disagree" for all the variables except for firm performance where the items were rated from 1 = "much better" to 7 = "much worse"). The operationalisation of key variables is presented below.

Dynamic Capabilities

The construct of DCs was measured adopting Teece, Pisano and Schuen's (1997:516) definition, i.e. "the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments", and Wang and Ahmed's (2007) three dimensions of DCs, i.e. adaptive capability, absorptive capability and innovative capability.

Adaptive Capability

Adaptive capability has been researched by many authors (Appendix 2). They have used different terms for the construct and have identified different dimensions and some of them have developed measures for the construct, for example, adaptive ability (Chakravarthy, 1982), adaptive capability (Oktemgil and Greenlay, 1996), and adaptability (Gibson and Brikinshaw, 2004). However, considering the clarity and the more focussed nature of the definition and higher reliability (Appendix 3) of measures, Gibson and Brinkinshaw's (2004) work was used in this study. Gibson and Brinkinshaw (2004:209) define adaptive capability (adaptability) of a firm as "the capacity to reconfigure activities in the business unit quickly to meet changing demands in the task environment". This ability to adjust will be reflected by the extent a firm encourage people to challenge outmoded traditions etc the flexibility to allow people to respond quickly to market changes, and the ability to evolve rapidly in response to changes in business priorities of firms (Gibson and Brikinshaw, 2004). Therefore, the 3-item scale developed by Gibson and Birkinshaw (2004) was adapted and used to measure adaptive capability of firms in this study (Table 4.3). Zhou and Li (2010) further developed Gibson and Brikinshaw's (2004) scale and the composite reliability was 0.78.

Absorptive Capability

Absorptive capability of a firm is defined as "the ability of a firm to recognize the value of new information, assimilate it, and apply to commercial ends" (Cohen and Levinthal, 1990:128). Since it was introduced by Cohen and Levinthal in 1990, many researchers have studied 'absorptive capacity' (absorptive capability) at different levels (Appendix 2), for example, firm level, inter-firm level etc. Some of the seminal work found in the literature are Cohen and Levinthal (1990), Szulanski (1996), Liu and White (1997), Deeds (2001), George et al. (2001), Zahra and George (2002), Liao, Welsch and Stoica (2003), Jansen, Van den Bosch and Volberda (2005a), Narasimhan, Rajiv and Dutta (2006), Fosfuri and Tribó (2008), García-Morales, Llorens-Montes and Verdu-Jover (2008) and Vega-Jurado, Gutierrez-Gracia and Fernández de Lucio (2008). Based on Cohen and Levinthal's (1990) definition, the measures developed and validated by García-Morales, Llorens-Montes and Verdu-Jover (2008) were used to measure the absorptive capability of firms.

Innovative Capability

Innovative capability refers to a firm's "capability of introducing new products to the market, or opening up new products to the market, opening up new markets, through combining strategic orientation with innovative behaviour and process" Wang and Ahmed (2004:304). Innovative capability research has its roots in Schumpeter's (1934) work. However, as presented in Appendix 2, different terms have been used to describe the concept of innovative capability, for example, innovation (Miller and Friesen, 1983), innovation capability (Lawson and Samson, 2001), innovative capability (Hagedoorn and Duysters, 2002; Subramaniam and Youndt, 2005), innovativeness (Calantone, Cavusgil and Zaho, 2002), organisational innovativeness (Wang and Ahmed,2004), and innovative competence (Quintana-Garcia and Benavides-Velasco, 2008). It should be noted here that, this study, measures innovative capability from an input perspective where the behavioural inputs of innovation are taken into consideration. In other words, the outputs of innovation such as the number of new products introduced by the firm, for example in the past three years, were not considered in measuring innovative capability of a firm.

However, among the above researchers of innovative capability, Calantone, Cavusgil and Zaho (2002) measures innovativeness of a firm from a capability perspective focussing on innovative behaviours of firms. As compared with other measures of innovative capability,

Calantone, Cavusgil and Zaho's (2002) measures have reported a high level of reliability. In addition, Lin (2007) used six items derived from Calantone, Cavusgil and Zaho (2002) to measure firm innovation capability and reported a high composite reliability. Composite reliability reflects the internal consistency of the indicators measuring a particular construct (Fornell and Larcker, 1981). The acceptable level of composite reliability is 0.70 (Fornell and Larcker, 1981). Hughes and Morgan (2007) adapted and used three items

Table 4.3. Operationalisation of Dynamic Capabilities Construct

Dimensions	Items*		Sources
Adaptive capability [1]	DC1	People in this firm are encouraged to challenge outmoded practices.	Adapted from Gibson and Birkinshaw (2004:217)
	DC2	This firm is flexible enough to allow us to respond quickly to changes in our markets.	
	DC3	This firm evolves rapidly in response to shifts in our business priorities.	
Absorptive capability[2]	DC4	This firm has a clear division of roles and responsibilities for acquiring new knowledge.	Adapted from. Garcia-Morales et.al.(2008:316)
	DC5	This firm has the necessary skills to implement newly acquired knowledge.	
	DC6	This firm has the competences to transform the newly acquired knowledge.	
	DC7	This firm has the competences to use the newly acquired knowledge.	
Innovative capability[3]	DC8	This firm introduces improvements and innovations in its business.	Hughes and Morgan (2007:659)
	DC9	This firm is creative in its methods of operation.	Adapted from Hughes and Morgan (2007:659)
	DC10	This firm seeks out new ways of doing things.	Adapted from Hughes and Morgan (2007:659)
	DC11	People in this firm get a lot of support from managers if they want to try new ways of doing things.	Adapted from 20-item scale by Wang and Ahmed (2004:307)

NOTE:*7-point Likert scales from1= "strongly disagree" to 7= "strongly agree"; 1.Reliability of the original scale α=.80; 2. Reliability of scales α=.85; 3. Reliability of the original scale α = 0.81 (Hughes and Morgan, 2007) and reliability of the original 20 item scale α = 0.91 (Wang and Ahmed , 2004).

taken from Calantone, Cavusgil and Zaho (2002) to measure innovativeness and the reliability of the items was reported as α = 0.81. Those items on Hughes and Morgan's (2007) scale measure innovative capability from an input perspective. Therefore, considering the total number of constructs measured in the study and the need for a short and comprehensive measure to capture innovative capability, Hughes and Morgan's (2007) 3-item scale along with one item taken from the scale developed and validated by Wang and Ahmed (2004) was used in this study. Adding an item from Wang and Ahmed (2004)

increases the validity of the measure making it into a 4-item scale that measures innovative capability from an input perspective.

The measures of DCs of firms that include Wang and Ahmed's (2007) three dimensions are given in Table 4.3.

The Success Trap

Different types of learning traps have been discussed in the extant literature. Appendix 2 presents seminal work related to the success trap that are available in the literature, for example, competency trap (Levitt and March, 1988), core rigidities (Leonardo-Barton,1992) and organisational pathologies (Ahuja and Lampert,2001). The original concept of learning traps was first introduced by Levinthal and March (1993:105) who define the concept as "…dynamics of learning that self destructively lead to excessive exploration or excessive exploitation". As it was discussed earlier, Levinthal and March (1993) identified two types of learning traps: the success trap and the failure tarp. For the reasons that have been already discussed, this study identifies the success trap as an important construct. Thus, one of its aims is to identify the effect of the success trap on DCs of firms. Accordingly, the study adopts Levinthal and March's (1993:106) definition of the success trap - "As they [firms] develop greater and greater competence at a particular activity, they engage in that activity more, thus further increasing competence and the opportunity cost of exploration".

Further elaborating the construct of the success trap, Ahuja and Lampert (2001) identified three organisational pathologies, i.e. familiarity trap, maturity trap and propinquity trap, in the context of breakthrough inventions in large firms. As mentioned earlier, familiarity trap refers to a tendency to favour the familiar over the unfamiliar, the maturity trap is associated with a tendency to prefer the mature over the nascent, and the propinquity trap is related to a tendency to search for solutions that are near to existing solutions rather than search for completely new solutions (Ahuja and Lampert, 2001). All three pathologies identified by Ahuja and Lampert (2001) above are considered in generating items to measure the success trap.

Six original items were developed to measure the success trap based on Levinthal and March (1993) and Ahuja and Lampert (2001) (Appendix 3). The items measured the extent firms were caught in the success trap (Table 4.4).

Table 4.4. Operationalisation of the Success Trap Construct

Items*		Source
ST1	Rather than trying to move into new technologies, this firm has been relying on a set of familiar technologies.	A new scale was developed based on Levinthal and March (1993) and Ahuja and Lampert (2001).
ST2	This firm has broken out its comfort zone of familiar technologies. (*Reverse coded*).	
ST3	This firm has been focusing on solving problems mainly through further development of mature technologies.	
ST4	This firm prefers to adopt technologies which are well-established in the industry rather than untested technologies in the industry.	
ST5	The tendency of this firm to look for solutions closer to existing technologies in the industry has been a barrier to develop pioneering solutions.	
ST6	This firm has been looking for new technologies that are fundamentally different from existing technologies in the industry (*Reverse coded*).	

NOTE: *7-point Likert scales from1= "strongly disagree" to 7= "strongly agree".

Market Dynamism

Following Jaworski and Kohli (1993) and Cui, Griffith and Cavusgil (2005), market dynamism is defined as the rate of change in the composition of customers and their preferences, the level of competition in the market, and the technology. Many researchers have studied the construct market dynamism under different terminologies in the extant literature (Appendix 2), for example, environmental context of organisations (Jaworski and Kohli, 1993), environmental dynamism (Jap, 1999; Miller, 1987; Miller and Friesen, 1982; Miller and Friesen, 1983), dynamic markets (Eisenhardt and Martin, 2000), market dynamism (Cui, Griffith and Cavusgil, 2005; Davis, Eisenhardt and Bingham, 2007) and environmental dynamism (Atuahene-Gima, 2005).

Market dynamism can be caused by different factors such as customers (Jaworski and Kohli, 1993; Miller and Friesen, 1982), competitors (Eisenhardt and Martin, 2000; Jaworski and Kohli, 1993; Miller and Friesen, 1982), technology (Jaworski and Kohli, 1993; Miller and Friesen, 1982; Tripsas, 1997), regulatory changes (De Vany and Walls, 1991; Lampel and Shamsie, 2003) and economic cycles (Wang and Ahmed, 2007). However, as indicated in the literature, the main causes of market dynamism are customers, competitors and technological changes.

This study measured market dynamism mainly along the above three dimensions: customer dimension, competitor dimension and technological dimension (Table 4.4). Jaworski and Kohli (1993:57) measured market dynamism (environmental dynamism) under the same three dimensions (Appendix 2): market turbulence ("the rate of change in the composition of customers and their preferences"), competitive intensity (the level of competition in the market) and technological turbulence ("the rate of technological change"). Miller (1987:74) also defines dynamism in the environment incorporating all three dimensions above.

Considering the number of constructs under investigation in this study and the need for shorter measures for the constructs, the original scale developed by Atuahene-Gima (2005) based on Jaworski and Kohli (1993) was used. Atuahene-Gima's (2005) measure covers the three components above, i.e. *technology* (Change in production/service technology); *competition* (Competitive intensity); and *customer* (The general rate of change in an industry). The measures of market dynamism used in this study are presented in Table 4.5.

Table 4.5. Operationalisation of Market Dynamism Construct[1]

Items*		**Source**
MD1	The actions of local and foreign competitors in our major markets were changing quite rapidly.	Atuahene-Gima (2005:69)
MD2	Technological changes in our industry were rapid.	Adapted from Atuahene-Gima (2005)
MD3	Technological changes in our industry were unpredictable.	
MD4	The market competitive conditions were highly unpredictable.	Atuahene-Gima (2005:69)
MD5	Customers' product preferences changed quite rapidly.	
MD6	Changes in customers' needs were quite unpredictable.	

NOTE: *7-point Likert scales from1= "strongly disagree" to 7= "strongly agree"; 1. Interrater reliability of the original scale r = .95

Entrepreneurial Capabilities: Exploratory Capabilities and Exploitative Capabilities

Entrepreneurial capabilities include exploratory capabilities and exploitative capabilities. Literature on exploration and exploitation reveals that the two constructs have been defined mainly from three perspectives: (1) as a behaviour/activity (e.g. Brady and Davis, 2004; Greve, 2007; He and Wong, 2004), (2) as a process (e.g. Ireland and Webb, 2007), and (3) as a competence/capability (e.g. Atuahene-Gima, 2005; Quintana-Garcia and Benavides-Velasco, 2008; Yalcinkaya, Calantone and Griffith, 2007). However, this study looks at exploration and exploitation from a capability perspective where they were identified as the key components of firm-level entrepreneurial capabilities. Thus, exploratory capabilities are defined as the capabilities of a firm in acquiring entirely new knowledge,

Table 4.6. Operationalisation of the Constructs Exploratory Capabilities and Exploitative Capabilities

Construct	Items*		Sources
Exploratory Capabilities[1]	EXPLOR1	Acquired manufacturing technologies and skills entirely new to the firm?	Atuahene-Gima (2005:69)
	EXPLOR2	Learned product development skills and processes entirely new to the industry?	Adapted from Atuahene-Gima (2005:69).
	EXPLOR3	Acquired entirely new managerial and organizational skills that are important for innovation?	
	EXPLOR4	Learned new skills in areas such as funding new technology, staffing R&D function, training and development of R&D, and engineering personnel for the first time?	Atuahene-Gima (2005:69)
	EXPLOR5	Strengthened innovation skills in areas where it had no prior experience?	
Exploitative Capabilities[2]	EXPLOIT1	Upgraded current knowledge and skills for familiar products and technologies?	Atuahene-Gima (2005:69)
	EXPLOIT2	Invested in enhancing skills in exploiting mature technologies that improve productivity of current innovation operations?	
	EXPLOIT3	Enhanced competencies in searching for solutions to customer problems that are near to existing solutions rather than completely new solutions?	
	EXPLOIT4	Upgraded skills in product development processes in which the firm already possesses significant experience?	
	EXPLOIT5	Strengthened our knowledge and skills for projects that improve efficiency of existing innovation activities?	

NOTE: *7-point Likert scales from1= "strongly disagree" to 7= "strongly agree"; 1. Composite reliability of the original scale = 0.83; 2. Composite reliability of the original scale = 0.86

skills, and processes (Adapted from Atuahene-Gima, 2005) and on the other hand, exploitative capabilities refer to the capabilities of a firm in refining and extending its existing product innovation knowledge, skills, and processes (Adapted from Atuahene-Gima, 2005: 62). A summary of research on exploration and exploitation is given in Appendix 2.

The 5-item scale developed by Atuahene-Gima (2005) was used to measure exploratory capabilities of a firm. Item 1, 4 and 5 were original items and item 2 and 3 of the original scales were adapted to make the items clear to the respondents (Appendix 3). Exploitative capabilities of firms were measured using the Atuahene-Gima's (2005) 5-item scale (Appendix 3). Taking the two constructs separately, they were measured using two unidimensional measures. A unidimensional measure is made of a set of indicators that

share only a single underlying factor (McDonald, 1981). Table 4.6 presents the measures of exploratory capability and exploitative capability used in this study.

Firm Performance

Following Knight (2000), firm performance of high-tech SMEs is defined as the extent to which the firm's financial and nonfinancial objectives are achieved through execution of firm's strategies. Panigyrakis and Theodoridids (2007) claim that use of Venkatraman and Ramanujam's (1986) both financial and non-financial (operational) indicators may provide a broad operationalisation of firm performance. Many researchers in the past have followed Venkatraman and Ramanujam (1986) in measuring firm performance. For example, Panigyrakis and Theodoridids (2007) measured retail business performance based on Venkatraman and Ramanujam's (1986) logic of firm performance and Rue and Ibrahim (1998) followed Venkatraman and Ramanujam's (1986) dimensions (i.e. financial and operational) in measuring small business performance. However, a problem arises here if high-tech SMEs have data on performance indicators suggested by Venkatraman and Ramanujam (1986) such as profitability, earning per share, market share etc. This reduces the applicability of Venkatraman and Ramanujam's (1986) dimensions and measures in this study on SMEs. A summary of measures of firm performance found in the literature is given in Appendix 2.

In light of the above brief discussion on the domain of the construct firm performance, sales growth, one of the items proposed by Venkatraman and Ramanujam (1986) and used by, for example, He and Wong (2004), Panigyrakis and Theodoridis (2007) and Wu et al. (2006), growth in profitability that is adapted from Lumpkin and Des (2006) and Wu et al. (2006), which is applicable to this study, employment growth one of the items adapted from Baum, Calabrese and Silverman (2000) and) and Robson and Bennett (2000), and increase in the physical location size that is adapted from Morris et al. (2006) were used to measure overall firm performance (Appendix 3).

He and Wong (2004) who used sales growth to measure firm financial performance claim that even if firm performance is a multidimensional concept, they focused only on average sales growth rate for several reasons: (1) availability and reliability and (2) a proxy indicator of other dimensions of superior firm performance. Panigyrakis and Theodoridis (2007) also used sales growth to measure firm financial performance. Furthermore, Wu et

al. (2006) used profitability and sales growth as measures of firm performance. Year on year employment growth (Baum, Calabrese and Silverman, 2000) and the growth in physical location (Morris et. al., 2006) have been used to measure non-financial firm performance. Thus, firm performance of UK high-tech SMEs was measured along two dimensions: financial performance (using sales growth and growth in profitability) and non-financial performance (using employment growth and the growth in the physical location size/business premises). This research used subjective measures of firm performance and the respondents were asked to compare their firm's performance in 2010 with that of 2008 and 2009 rating from 1 = "much worse" to 7 = "much better". As mentioned in Chapter 2, prior research recommends that subjective measures of performance are consistent with objective measures (Dess and Robinson, 1984; Dess, Lumpkin and Covin 1997; Knight, 2000; Pearce, Robbins, and Robinson, 1987; Slater and Narver, 1994; Venkatraman and Ramanujam, 1987). The measures of firm performance are presented in Table 4.7.

Table 4.7. Operationalisation of the Construct Firm Performance

Dimension	Items*		Sources
Financial Performance	FP1	Sales growth	Adapted from Wu et al., (2006) and He and Wong (2004)
	FP2	Growth in profitability	Adapted from Lumpkin and Des (2006) and Wu et al., (2006)
Non-Financial Performance	FP3	Increase in the number of employees	Adapted from Baum, Calabrese and Silverman (2000) and Robson and Bennett (2000)
	FP4	Increase in the physical location size	Adapted from Morris et al.(2006)

NOTE: *From 1 = "much worse" to 7 = "much better".

Control Variables

The effect of the variables firm size, firm age, R&D intensity, marketing intensity, and number of patents were controlled in the analysis. The measures are presented in Table 4.8.

Firm Size

Firm size refers to the number of employees in the firm respectively. Firm size was measured taking the number of people employed in a firm. For example, Keeble et al. (1998), Atuahene-Gima (2005) and Yasuda (2005) used number of employees as a measure of firm size. Traditional measures of firm size such as sales would not be appropriate since most hi-tech firms may not yet have any products on the market (Shan, 1990).

Firm Age

Firm age is defined as the number of years a firm has been in operation since the date of establishment. Firm age was measured based on the number of years the firm has been in business since its inception. Hansen (1992) and Keeble et al. (1998) used number of years in operation as a measure of firm age.

R&D Intensity

R&D intensity indicates how much money out of the sales revenue of a firm is spent on R&D. This is an indicator of the level of exploratory capabilities of a firm. R&D intensity was measured as a ratio between R&D expenditure and the sales revenue.

Marketing Intensity

Marketing intensity shows how much money out of the sales revenue spent on marketing and this was used as an indicator of the exploitative capabilities of a firm. Marketing intensity was measured based on the ratio between marketing expenditure and the sales revenue.

Number of Patents

In addition to the multi scale measure, number of patents was used to measure the level of innovative capability of a firm. Pilkington, Dyerson and Tissier (2002) confirmed that patents are a rich indicator of technological development in the context of automobile industry.

Table 4.8. Operationalisation of Control Variables

Variable	Measure	Sources
Firm Size	Number of employees.	Keeble et al. (1998), Atuahene-Gima (2005) and Yasuda (2005)
Firm Age	Number of years since the date of establishment of the firm.	Hansen (1992) and Keeble et al. (1998)
R & D Intensity	R & D expenditure/Sales revenue	He and Wong (2004)
Marketing Intensity	Marketing expenditure/Sales revenue	Kotabe, Srinivasan and Aulakh (2002)
Number of Patents	Number of patents	Acs and Audretsch (1989)

4.6.3. Designing the Questionnaire and Purifying Measures

The questionnaire for the study was designed incorporating the above items to measure each construct. The respondents were asked to rate each item on a 7-point Likert scale from 1 = "strongly disagree" to 7 = "strongly agree" and for the firm performance scale items from 1 = "much worse" to 7 = "much better" as compared with their own

performance in 2008 and 2009. Reverse-coded questions were also used to avoid response acquiescence (Ray, 1979) and inattention by respondents. In addition to that, questions on the respondent profile (gender, age group, job title, number of years working in the firm and number of years working in the industry), and a few open-ended questions (what are the key challenges in the industry? how does your firm intend to meet the challenges? what new resources/capabilities do you need to achieve the above?) were asked to get an overview of the level of DCs of the firms were included in the questionnaire.

The questionnaire was pre-tested among a sample of seven PhD researchers who have worked in the industry holding managerial level positions in different industries and an academic who has experience in the relevant field at the School of Management, Royal Holloway, University of London. Based on their feedback, the wordings of selected questions, the format of the questions, and the order of the questions were changed. The results of the *reliability* and *validity* tests based on the actual survey data are presented in Chapter 5.

4.6.4. Conducting the Survey

Following the receipt of the ethics approval from Royal Holloway, University of London (Appendix 4), the data collection was started. First, the survey was conducted, between March 2011 and August 2011, following Dillman's (2000) guidelines for data collection and Huber and Power's (1985) method on how to obtain quality data from key informants. Only senior executives were selected as key informants of firms in the sample considering their knowledge of the topics under investigation (Wang et al., 2007). Each intended informant was sent a questionnaire (Appendix 6) along with a personally addressed cover letter (Appendix 5) and a pre-paid self-addressed envelope. It has been reported that such practices would increase the response rate (Dillman, 2000; Edwards et al., 2002; Webb, 1992). The cover letter requested the respondents to return the completed questionnaire within two weeks from the date they received the survey. Three weeks after sending out the survey, the non-respondents were contacted by telephone to follow up with the aim of increasing the response rate (Dillman, 2000).The response rates can be found in Section 4.12.

4.6.5. Methods of Quantitative Data Analysis

The quantitative data were screened first and then an exploratory data analysis was carried out using descriptive statistics, correlations and cross-tabs, and analysis of variance (ANOVA) for the data on key constructs. The descriptive statistics give an overall, coherent, and straight forward picture of the large amount of survey data (Struwig and Stead, 2001). These statistics were useful in checking if the data set meets the assumptions for applying multivariate statistical tests. The study used ANOVA, the most commonly used technique, to compare the means of groups of data. However, Camilli and Shepard (1987) argue that ANOVA may fail to detect even large amounts of group bias. It has also been argued that categorisation used in ANOVA can result in a loss of information and in turn make the analysis less sensitive (Pedhazur, 1982).

Next, the data on scale items measuring key constructs were subjected to exploratory factor analysis (EFA) as the first multivariate technique in preparing for other multivariate techniques such as hierarchical regression (Hair et al., 1998). EFA is considered as simpler method (Stevens, 1996) and is useful in generating an empirical summary of the data set (Tabachnick and Fidell, 2007). More importantly, as one of the objectives of this research is operationalising and developing measures for the construct of DCs whose components have not been empirically tested, and the success trap, use of EFA is more appropriate (Stevens, 1996). However, Armstrong (1967) criticises factor analysis, particularly EFA, for its limited utility in theory development as it may fail to provide meaningful insights into data.

This was followed by a hierarchical regression analysis to test the research hypotheses (H_1, H_2, H_3, H_4, H_6 and H_7) except H_5 that was tested using correlation analysis. Based on the evidence from the literature, it is assumed that exploratory capabilities and exploitative capabilities can covary rather than one predicting the other like in the case of the rest of the hypotheses. Therefore, correlation analysis would be the best way to test the relationship between the two types of capabilities. Moreover, since it is continuous data, the Pearson product-moment correlation was used to test H_5 (Pallant, 2010). The advantage of employing regression analysis is that the researcher could specify the order of entry of variables (Tabachnick and Fidell, 2007) and control the effect of selected variables. However, relying on the assumption of linearity between the underlying variables and the

measures used can be a major limitation of hierarchical regression analysis (Busemeyer and Jones, 1983).

4.7. Qualitative Data Collection and Analysis

The next stage of the study involved collecting qualitative data to further understand the key constructs and the relationships among those constructs. Semi-structured interviews that followed the questionnaire survey were used as a complementary method of data collection in this study. Data, collected through semi-structured interviews that were conducted between June 2011 and September 2011, were subjected to qualitative analysis and were used to answer not only 'what' and 'how' but also to explore 'why' question of the research (Saunders, Lewis and Thornhill, 2007).

As claimed by Wholey, Hatry and Newcomer (2010), semi-structured interviews are useful in probing into important questions that cannot be addressed in a standardised survey. The disadvantage of semi-structured interviews is that they take a considerable time and effort in preparing for the interview, setting up and conducting the interview, and analysing interview data (Wholey, Hatry and Newcomer, 2010). Thus, while further examining the findings of the main mail survey, conducting semi-structured interviews was aimed at getting insights into the constructs the success trap, market dynamism, DCs and the relationship between the latter two constructs and DCs, and the influence of DCs on entrepreneurial capabilities of exploration and exploitation in UK high-tech firms.

4.7.1. Sampling of the Semi-Structured Interviews

From the above effective sample of 113 firms that responded to the survey and expressed their interests in participating the interviews, 20 senior executives representing 20 firms, across all five high-tech industries were selected for the semi-structured interviews: aerospace (4 firms); pharmaceuticals and biotechnology (5 firms); office and computing (5 firms); radio, TV and communication (3 firms); medical and optical equipment (3 firms).

Similar strategy was adopted by Crick and Spence (2005) who identified firms for their case studies from responses to a mail survey undertaken in 2002. One informant from each firm was chosen due to constraints of time and cost, and their expertise in the relevant area and willingness to discuss the issues (Crick and Spence, 2005). The composition of the sample of interviewees is given in Table 4.9.

Table 4.9. Composition of the Sample of Interviewees

Industry	Firm	Interviewee
Aerospace	Aero-1	Chief Executive Officer
	Aero-2	Sales Engineer
	Aero-3	Business Development Manager
	Aero-4	Marketing Manager
Pharmaceuticals and Biotechnology	P&B-1	Managing Director
	P&B-2	Managing Director
	P&B-3	Bioanalytics Project Manager
	P&B-4	Chief Executive Officer
	P&B-5	Executive Chairman
Office and Computing (IT)	O&C-1	IT Consultant
	O&C-2	Executive Chairman
	O&C-3	Managing Director
	O&C-4	Lead Architect-Hardware Systems
	O&C-5	Research Director
Radio, TV and Communication	RT&C-1	Sales Director
	RT&C-2	Finance Director
	RT&C-3	Commercial Manager
Medical and Optical Equipment	M&O-1	Managing Director
	M&O-2	Chief Administrator
	M&O-3	Marketing Manager

4.7.2. Conducting Semi-Structured Interviews

The semi-structured interviews were conducted next. For the semi-structured interviews, out of the 113 firms where senior executives responded to the survey, as mentioned earlier, interviewees from 20 firms, one representing each firm, across all five industries were randomly selected, based on their willingness to participate the interviews (Appendix 7). The interviews were conducted using a semi-structured interview guide (Appendix 8). Out of the 20 interviews, 2 were conducted face-to-face and the remaining 18 interviews were conducted over the telephone as the interviewees were based in different parts of the UK and conducting face-to-face interviews were practically difficult due to the time, money and other limitations. Each interview was 30-60 minutes duration and all the interviewees were sent a written request by e-mail seeking their consent for voice recording the interviews. Thus, all the interviews were voice recorded and transcribed by the researcher. The interviewees were contacted by telephone for clarifications of unclear comments. The detailed profiles of firms/interviewees are given in Table 6.1 in Chapter 6.

4.7.3. Methods of Qualitative Data Analysis

The interviews were transcribed and analysed mainly adopting the qualitative data analysis techniques recommended by Miles and Huberman (1994). In addition, there were implications for the analysis from Strauss and Corbin's (1990) seminal work and other related scholarly contributions (e.g. Gilgun, 2005; Hyde, 2000). Furthermore, following

Eisenhardt (1989) and Andriopoulos and Lewis (2009), the data were identified under indicative themes to gain further insights into the key constructs.

Thus, the qualitative method of thematic analysis that used theory-driven deductive approach where a deductive a priori template of codes (Crabtree and Miller, 1999) was used. However, the process of data analysis allowed emergence of new codes that would lead to new themes as well. First, a theory-driven codebook was developed. Second, a data matrix was prepared to analyse interview data identifying interview responses on key constructs of the study (Miles and Huberman, 1994).The interview quotes were selected based on the most representative quotes. The use of a data matrix allowed a systematic display of the relevant condensed data set. Third, the codes were applied to identify meaningful units of text on the data matrix. Fourth, connecting the codes, the themes were identified and confirmed. In this stage, the interview responses were grouped under first order concepts that lead to the second order themes consequently resulting in the aggregate dimensions. The themes demonstrate the common patterns of the key constructs (categories) and the aggregate dimensions were focused on the relationships among those constructs (categories). The qualitative data analysis was mainly aimed at identifying firm-specific routines of DCs and gaining insights in to the quantitative findings.

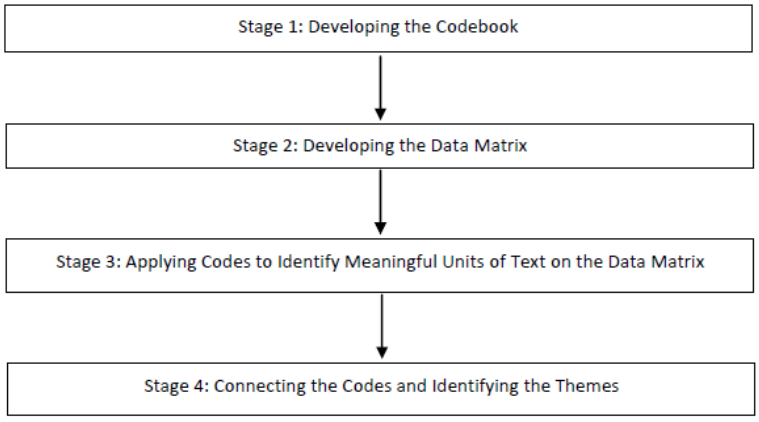


Figure 4.2. The Qualitative Data Analysis Process

4.8. Triangulation

Denzin (1978: 291) defines triangulation as "the combination of methodologies in the study of the same phenomenon" and presents four basic types of triangulation: data,

investigator, theory and methodology. Employing two methods, this study used methodological triangulation (Denzin, 1978) where quantitative survey method and qualitative interview method were employed (Silverman, 2001). Triangulation using quantitative surveys and qualitative fieldwork improve internal and external validity as it combines separate research strategies in one study (Scandura and Williams, 2000). Furthermore, the two methods used in this study are nonoverlapping (Johnson and Turner, 2003) and they demonstrate complementary strengths (Morgan, 1998).

The quantitative survey was the main method of the study. The advantage of survey method is that the findings are more representative of the population and the disadvantage is that each firm is not studied in depth (Chesbrough, 1999). However, the qualitative study of 20 firms out of the 113 firms participated in the survey has minimised the above disadvantage of using survey method as the only method that has been pointed out by Chesbrough (1999). The quantitative survey was followed by the qualitative semi-structured interviews. Thus, quantitative survey helped understand the full population whereas the qualitative interviews revealed rich firm specific data of selected high-tech SMEs. Furthermore, the nature of the constructs examined in this study warrants the use of both quantitative and qualitative methods. For example, adopting multiple methods would be more relevant in studying constructs such as DCs (King and Tucci, 2002), given the fact that DCs can be firm-specific whilst there can be commonalities of DCs across firms (Eisenhardt and Martin, 2000; Wang and Ahmed, 2007).

4.9. Common Method Variance

Survey method was the main method of data collection in this study. However, severe problems could arise in survey research when measures of variables are collected from the same respondents (Podsakoff and Organ, 1986) resulting in common method variance (Campbell and Fiske, 1959). The single-informant who represents a firm may have a limited knowledge or may give a biased view of the entire firm affecting the reliability of subjective data on variables, i.e. they could be artificially related to data on other variables (Reinartz, Krafft and Hoyer, 2004). In other words, because all the data come from a single source, any defect in that source contaminates data on all the variables (Podsakoff and Organ, 1986). Therefore, Podsakoff and Organ (1986) suggest the use of procedural and statistical and post-hoc methods to address the problem of common method variance.

Out of the procedural strategies recommended by Podsakoff and Organ (1986), scale reordering that was appropriate to this research was applied in designing the questionnaire. Accordingly, the scales were reordered so that the measures of dependent variables follow, rather than precede, those of independent variables (Salancik and Pfeffer, 1977) (e.g. the measures of DCs followed those of the market dynamism). In addition, all the measures of different variables were presented under separate sections. As statistical and post-hoc strategies, widely accepted Harman's (1967) *one factor test* was performed (Appendix 11). All the data on Likert scale items were subjected to EFA to test if substantial amount of common method bias was present (Podsakoff and Organ, 1986): however, 13 factors with eigenvalues greater than one that explain 73% of the total variance emerged in the factor analysis and the largest factor explained only 11% of the variance. Thus, Harman's (1967) *one factor test* confirms that there was no evidence of common method variance in this study.

4.10. Preliminary Results and Data Screening

4.10.1. Response Rate

As described above, 1211 high-technology firms representing all five high-technology industry categories of the OECD (2003) classification were surveyed in the study (Table 4.10).

Table 4.10. Analysis of the Survey Responses

	Number	**Percentage**
The sample size (questionnaires sent out)	1211	
Questionnaires undelivered and returned	(41)	
Questionnaires undelivered or missing (based on follow ups)	(648)	
The effective sample size	**522**	
Refused to participate in the survey (based on follow ups)	388	
Questionnaires answered and returned	134	(134/522)*100= 25.67%
Non-usable questionnaires	(21)	
The effective responses	**113**	(113/522)*100= 21.65%

Out of the 1211 questionnaires sent out, as it was revealed in telephone follow-ups, 648 questionnaires had not reached the intended respondents resulting in an effective sample size of 522 firms. As suggested by Armstrong and Overton (1977), the total sample consists of firms who were presumably contacted, and those who could not be reached (i.e. whose questionnaires were undelivered) should be excluded. Therefore, the above 522 can

be considered as the total sample of the study. Out of the 522 questionnaires delivered, only 134 were answered and returned yielding a 25.67% raw response rate (e.g., Daniel, 2003; Sher et al., 2004; Tu et al., 2006). Out of the above 134 questionnaires, due to incomplete responses, only 113 questionnaires were found usable resulting in a 21.65% effective response rate (Table 4.10). The effective response rate of 21.65% is well above the 10-12% rate that is typical for surveys of executives (Hambrick, Geletkanycza and Fredrickson, 1993).

Table 4.11. Reasons for Not Taking Part in the Survey

Reason	**Frequency**	**Percentage**
No time to complete the survey/busy	126	32.47%
Survey is not relevant to the firm[1]	119	30.67%
Not interested	63	16.24%
Policy of the firm	29	7.47%
Contact person has left the firm	27	6.96%
Wrong contact person	19	4.90%
Contact person is away	5	1.29%
TOTAL	**388**	**100**

NOTE: 1.Firms in high-tech industries (OECD, 2003) can produce a variety of products ranging between low-tech and high- tech (OECD, 2011). As it was found in the telephone follow-ups of the survey, probably due to the above reason, some firm do not identify themselves as "high-tech" even though they operate in high-tech industries.

In order to increase the response rate, both financial (giving the respondents an opportunity to win a gift voucher in a draw) and non-financial response inducement-techniques (offering to share an executive summary of findings of the study with the participating firms) were used considering the varying enhancing effects of those techniques on response rates for top executives (Anseel et al., 2010). In addition, personalised cover letters with the researcher's signature, that has been found to be effective in enhancing response rates (Yammarino, Skinner and Childers, 1991; Yu and Cooper, 1983), were sent along with the questionnaire. It is important to have a good response rate, as a low response rate could lead to biases (Groves, 2006; Tomaskovic-Devey, Leiter and Thompson, 1994). However, 10%-20% response rate can be the norm for firm-level surveys (Paxson, 1992) and low response rate is not uncommon in mail surveys in general (Collis and Hussey, 2003; Dillman, 2000; Tomaskovic-Devey, Leiter and Thompson, 1994). As far as recent surveys among UK high-tech and related SMEs are concerned, the above effective response rate of this study can be considered as acceptable. For example,

Johnson (2004) reports a 19.25% response rate in a mail survey, Cosh and Hughes (2009) received a 17.5% response rate in telephone and mail survey, and Oke et al. (2007) got a 13.8% response rate in a web based survey. As it was revealed in telephone follow ups, there were 388 firms that did not want to take part in the survey due to various reasons (Table 4.11) Furthermore, similar reasons have been reported in the survey research literature (e.g. Fenton-O'Creevy,1996).

4.10.2. Non-Response Bias

The non-response bias that is a result of having a final sample of respondents that is not representative of the initial sample of the study, can affect the representativeness of the sample that will reduce the generalisability of the findings of the study. As pointed out by Dillman (2000) and De Vaus (2002), the non-response bias could occur due to systematic difference in the two groups that could be reflected in their responses. In this study, the non-response bias was estimated based on time trends (Ferber, 1948) where firms responded late were assumed to be more similar to nonrespondents (Armstrong and Overton, 1977).

The Analysis of Variance (ANOVA) test and the Chi-square test were conducted to check for the non-response bias. As presented in Table 4.12, the respondents were divided into two groups based on the date of responses: 'early responses' (the responses received on or before the due date) and 'late responses' (the responses received after the due date).Table 4.12 shows that the respondents in the final usable sample are almost equally distributed among the early and late respondent groups (i.e. Early = 47.80% and Late = 52.20%).

Table 4.12. Early and Late Responses

		Frequency	**Percentage**
Valid	Early (Received by the due date)	54	47.8%
	Late (Received after the due date)	59	52.2%
	TOTAL	**113**	**100.0**

One Way ANOVA Test: Nonresponse Bias for the Key Constructs

The importance of testing the non-response bias in substantive variables has been highlighted in the literature as it can undermine the representativeness and validity of survey-based research (Van Goor and Van Goor, 2007). Therefore, a one-way ANOVA test was conducted to explore the impact of response time (i.e. early respondents and late

respondents) on the key constructs market dynamism, the success trap, DCs, exploratory capabilities, exploitative capabilities and firm performance.

Table 4.13. Non-Response Bias: One-Way ANOVA: Test of Homogeneity of Variances

	Levene Statistic	df1	df2	Sig.
The Success Trap	2.912	1	111	.091
Market Dynamism	.198	1	111	.658
Dynamic Capabilities	1.201	1	111	.275
Exploratory Capabilities	.002	1	111	.964
Exploitative Capabilities	.937	1	111	.335
Firm Performance	6.195	1	111	.014

Table 4.14. Non-Response Bias: One-Way ANOVA: Robust Tests of Equality of Means

		Statistic[a]	df1	df2	Sig.
Firm Performance	Brown-Forsythe	2.209	1	94.562	.141

a. Asymptotically F distributed.

Table 4.15. Non-Response Bias: One-Way ANOVA Test for Key Continues Variables

		Sum of Squares	df	Mean Square	F	Sig.
The Success Trap	Between Groups Within Groups Total	0.030 70.563 70.594	1 111 112	0.030 0.636	0.048	0.828
Market Dynamism	Between Groups Within Groups Total	0.013 92.408 92.420	1 111 112	0.013 0.833	0.015	0.902
Dynamic Capabilities	Between Groups Within Groups Total	0.146 86.836 86.982	1 111 112	0.146 0.782	0.187	0.666
Exploratory Capabilities	Between Groups Within Groups Total	0.001 152.897 152.898	1 111 112	0.001 1.377	0.001	0.978
Exploitative Capabilities	Between Groups Within Groups Total	0.051 80.669 80.720	1 111 112	0.051 0.727	0.070	0.791
Firm Performance	Between Groups Within Groups Total	2.210 107.791 110.001	1 111 112	2.210 0.971	2.276	0.134

The results (Table 4.13) revealed that, except firm performance where $p = 0.01$, the homogeneity of variance assumption, i.e. the assumption that the variances between the independent groups are equal, is met ($p > 0.05$) for the Levene Statistic for all the variables. However, for the firm performance scores, the Brown-Forsythe statistic (Table 4.14) was not significant at 5% level where p = 0.14. The Brown-Forsythe statistic is preferable when the homogeneity of variance assumption is violated (Pallant, 2010). This still indicate a statistically non-significant difference in mean values of firm performance score between the two groups. Thus, overall, as it can be seen in the ANOVA table (Table 4.15), there was no significant difference at $p < 0.05$ significance level in scores on all the key

constructs for the early respondent group and the late respondent group, $p = 0.13$ for firm performance being the lowest value.

The differences between early and late respondents in terms of categorical variables, i.e. firm size (micro, small and medium), firm age (new, young, adult and old), and the five high-tech industry types, were tested using the Chi-square test.

Chi-Square Test: Firm Size

Based on the analysis of the number of employees in the firms in the effective sample of the study, following the European Commission's (2005) classification, the respondent firms were divided into three groups depending on the number of employees: *micro* (1-9 employees), *small* (10-49 employees), and *medium* (50-249 employees). Appendix 9 presents the number of early and late responses among different firm sizes. As given in Appendix 9, Chi-square test indicated, at 5% significance level, no significant association between the response time (early and late) and firm size ($\chi^2 = 4.83$; df = 2; $p = 0.09$). Further, this is confirmed by the small effect size that has been reported for Cramer's $V = 0.21$ (less than cutoff .30) showing a small effect size (Pallant, 2010). In addition, all the expected cell sizes are greater than 5, which indicates that the assumption of 'minimum expected cell frequency' has been met (Pallant, 2010).

Chi-Square Test: Firm Age

Adapting from Abor (2005) who classified firms into three groups based on the number of years in business, i.e. 'young' (3-less than 6 years), 'adult' (6-10 years) and 'mature' (over 10 years), the respondent firms of the study were classified in to four age groups: 'New' (3-less than 6 years), 'Young' (6-10 years), 'Adult' (11-25 years) and 'Old' (over 25 years). Chi square test was used to compare the two groups of respondents with reference to firm age (Appendix 9).The results of the Chi-square test reveal that at 5% significance level, there is no significant difference between early and late respondents across the distribution of firm age ($\chi^2 = 1.84$; df = 3; $p = 0.61$). This is confirmed by the small effect size that has been reported for Cramer's $V = 0.12$ (less than .30) (Pallant, 2010). It should also be noted here that, all the expected cell sizes are greater than 5, which indicates that the assumption of 'minimum expected cell frequency' has been met (Pallant, 2010).

Chi-Square Test: Industry Type

A Chi-square test was employed to test any association between the two groups with regard to the industry type. Appendix 9 presents the distribution of the two groups across different types of high-tech industries. As given in Appendix 9, Chi-square test revealed that, at 5% significance level, no significant association between the early responses and late responses across the distribution of industry type (χ^2 = 4.07; df = 4; p = 0.40). In addition, the small effect size that was reported for Cramer's V = 0.19 (less than cutoff 0.30) substantiated the above results (Pallant, 2010). More than 80% of the expected cell sizes are greater than 5, which indicates that the assumption of 'minimum expected cell frequency' has been met (Pallant, 2010).

4.10.3. Data Screening

Item Nonresponse Bias and Missing Data

Item non-response bias occurs due to "failure to answer one or more of the questions" (Hoinville and Jowell, 1978: 137). This includes the questionnaires returned incomplete (Fraenkel and Wallen, 1993) and does not include questions that are not mandatory. Respondents may not answer a particular question due to lack of knowledge, refusal to answer or unintentional skipping of the question (Batista and Monard, 2003; Helms, 1999; Shoemaker, Eichholz and Skewes, 2002). Furthermore, the missing data randomness can be of three types (Little and Rubin, 1987; Tabachnick and Fidel, 2007): missing completely at random (MCAR), missing at random (MAR), or not missing at random (NMAR).

Different methods of handling missing data have been discussed in the literature (Little and Rubin, 2002; Roth, 1994; Tabachnick and Fidel, 2007). The methods proposed by Tabachnick and Fidel (2007) represent the generally accepted methods of handling missing data: (1) Deleting cases or variables; (2) Estimating missing data: This can be done by using prior knowledge; inserting mean values; using regression; expectation-maximization; and multiple imputation, (3) Using a missing data correlation matrix: using all available pairs of values to calculate each of the correlations in a correlation matrix, (4) Treating missing data as data: creating a dummy variable and assigning 0 to the cases with complete data and 1 to the cases with missing data and then is inserting the mean for missing values (Cohen et al., 2003) or (5) Repeating analyses with and without missing data. If only 5% or less data points are missing in a random pattern, the problems are less serious and any handling method would be appropriate (Tabachnick and Fidel, 2007). It was clear that

above data were missing completely at random and no systematic analysis of randomness was performed as there were only a small number of cases of missing data.

As it was mentioned earlier, 21 incomplete questionnaires that were unusable were dropped in the initial screening. As far as the 113 usable questionnaires are concerned, missing values were reported on firm size, firm age, R&D intensity, marketing intensity, number of patents, item DC9 on the DCs scale, items EXPLOIT8 and EXPLOIT9 on the exploitative capabilities scale, and item ST9 on the success trap scale. With reference to questions on respondent profile, there were missing values only on the respondent's job position. Table 4.16 presents the frequency of missing data and how they were handled in this study.

As it can be seen in Table 4.16, the highest percentage of missing values as a percentage of total number of usable questionnaires was for firm age that was 5.31%. Among the rest of the missing values, the lowest percentage was 0.9% and the highest was 4.4%. Percentages of R&D Intensity were used in the quantitative data analysis. In cases where the exact percentages of R&D Intensity were missing, data retrieved from the R&D Intensity Scale relevant to each firm (Appendix 6, Section 5: Question Number 11). Similarly, in cases where the exact percentages of the Marketing Intensity were missing, the data were replaced with data from the Marketing Intensity Scale (Appendix 6, Section 5: Question Number 12).

As far as the data on the profile of the firm are concerned, the missing values on firm size and firm age were handled using mean substitution where the missing values were replaced with the series means (Tabachnick and Fidel, 2007). There was only one case with missing data on the job position of the respondent that comes under respondent profile, and this was ignored as it was not so critical to the findings of the study. When it comes to the missing data on informative questions, as mentioned above, the missing values on R&D Intensity (Percentage) were substituted with the mid values of the relevant class of percentages marked by the respondent where available. The missing values on marketing intensity were also handled adopting a similar method where the missing data were replaced with the mid values of the relevant class of percentages marked by the respondent. In cases where any of the above data on R&D Intensity (Percentage) (There were only 2 cases.) and Marketing Intensity (Percentage) (There was only 1 case.) were not available,

the missing values were replaced with series means of R&D Intensity (Percentage) data for R&D intensity and with series means of Marketing Intensity (Percentage) for marketing intensity (Tabachnick and Fidel, 2007).The mean substitution method was used in handling the missing values on the items measuring constructs DCs, exploitative capabilities and the success trap (Tabachnick and Fidel, 2007).

Table 4.16. Frequency of Missing Data and How They Were Handled

Type of Question	Question	Frequency of Missing Data	Percentage of Missing Data	Handling Method
Profile of the firm	Firm Size (based on number of employees)	1	0.9%	*Mean substitution*
	Firm Age (based on the year of establishment)	6	5.31%	*Mean substitution*
Profile of the respondent	Job Position	1	0.9%	*Not critical. Ignored.*
Informative questions	R&D Intensity (Percentage)	3	2.7%	*Mean substitution OR if available, the mid value of the relevant class of percentages marked on R&D Intensity (Scale).*
	R&D Intensity (Scale)	2	1.8%	*Data were not used. Missing values ignored.*
	Marketing Intensity (Percentage)	2	1.8%	*Mean substitution OR if available, substituting the mid value of the relevant class of percentages marked on Marketing Intensity (Scale)*
	Marketing Intensity (Scale)	2	1.8%	*Data were not used. Missing values ignored.*
	Number of Patents	5	4.4%	*Data were not used. Missing values ignored.*
	Number of Patents (Scale)	4	3.5%	*Replaced with 0.*
Items measuring the constructs	DC9: This firm is creative in its methods of operation.	2	1.8%	*Mean substitution*
	EXPLOIT8: Enhanced competencies in searching for solutions to customer problems that are near to existing solutions rather than completely new solutions.	1	0.9%	*Mean substitution*
	EXPLOIT9: Upgraded skills in product development processes in which the firm already possesses significant experience.	1	0.9%	*Mean substitution*
	ST9: This firm has kept investing its resources in similar kind of projects that have not resulted in new technologies.	1	0.9%	*Mean substitution*

Outliers

Tabachnick and Fidell (2007: 72) define outliers as "a case with such an extreme value on one variable (a univariate outlier) or such a strange combination of scores on two or more variables (multivariate outlier)". Simply, an outlier can be the cases with values well above or well below the majority of other cases (Pallant, 2010:64).

Table 4.17. Handling Univariate Outliers

Variable	No. of Univariate Outliers Identified Based on Z-Score (Beyond + Or -3.29) and/or Boxplot	How Handled
Firm Size	4	The scores on the variables for the outlying cases were changed by assigning the outlying cases a raw score on the offending variable that is one unit larger (or smaller) than the next most extreme score on the distribution (Tabachnick and Fidell, 2007:77).
Firm Age	2	
R&D Intensity	10	
Marketing Intensity	3	
Dynamic Capabilities	3	
Exploratory Capabilities	2	
Exploitative Capabilities	2	
Firm Performance	4	

These steps were followed in handling outliers. First, univariate outliers for the continuous variables (Table 4.17) were checked using standardized scores (z-scores) and boxplots. Following Tabachnick and Fidel (2007), cases with z-scores beyond ± 3.29 ($p < .001$, 2-tailed test) were detected as outliers and further outliers were identified by inspecting boxplots with points extending more than 1.5 box-lengths from the edge of the box (Pallant, 2010). Second, the histograms were also inspected in locating the above outliers. Third, a 5% trimmed mean was examined to assess the likely influence of these outlying cases. As the first step in dealing with the outliers, the accuracy of data entered was checked and it was found that there were no mistakes in data entry. All the outliers were a part of the population under study and were extreme cases in the distribution. Therefore, the outlying cases were changed by assigning the outlying cases a raw score on the offending variable that is one unit larger or smaller than the next most extreme score on the distribution (Tabachnick and Fidell, 2007:77).

After dealing with the univariate outliers, multivariate outliers were searched using the *Mahalanobis distance* which is "a measure of the distance in multidimensional space of each observation from the mean center of the observations" (Hair et al., 1998:66). The Mahalanobis distance was computed for combinations of all the key constructs and the values were evaluated for each case using Chi-square (χ^2) distribution. Applying the probability estimate $p < .001$ for χ^2 value (Tabachnick and Fidell, 2007:74), no multivariate outliers were located indicating that combination of values on the above constructs did not result in any

outliers. Multivariate outliers were searched and the results were presented under the assumptions for hierarchical regression analysis.

Since this study uses grouped data in some tests (e.g. ANOVA) where subjects are subdivided into groups (Tabachnick and Fidell, 2007), outliers were sought within groups as well. Only a few outliers were detected and they were not significantly deviating from the normal distribution. Therefore, the original (raw values) of those cases were retained.

Normality

The continuous variables were screened for normality as it is "an important early step in almost every multivariate analysis" (Tabachnick and Fidell, 2007: 79). In this study, normality of the variables was assessed using both graphical and statistical methods. Initially, histograms, normal probability plots and detrended normal probability plots were used as the graphical method to assess normality. Then, mainly, Skewness and Kurtosis, two components of normality, were used as the statistical methods. "The skewness value provides an indication of the symmetry of distribution" whereas "kurtosis provides information about 'peakedness' of the distribution" (Pallant, 2010:57). In addition, Kolmogorov-Smirnov (KS) statistic was also inspected to assess normality of distribution of scores. Kolmogorov-Smirnov (KS) statistic is used to test if the actual distribution of the variable is equal to the expected distribution (if the variable was normally distributed), and the *p* value of the results of the test is examined to determine the significance of the difference between the actual and expected distributions.

First, based on graphical methods (Appendix 10), an inspection of histograms of the distributions of each variable shows that the distributions were reasonably normally distributed. This was substantiated by the normal probability plots (Normal Q-Q Plots) where the observed values for each score were plotted against the expected value from the normal distribution. All the graphs presented fairly straight lines suggesting normal distributions. The detrended normal Q-Q plots were obtained from plotting the actual deviation of the scores from the straight line and most of the lines were collecting around the zero line.

Second, normality was further tested using statistical methods and in order to test skewness and kurtosis, z-scores were calculated by dividing skewness value by the standard error for skewness and by dividing kurtosis vales by standard error for kurtosis respectively (Appendix

10). Z-scores were assessed following ±3.29 cutoff recommended by Tabachnick and Fidell (2007). It was found that the z-scores of skewness test for firm size, firm age and marketing intensity are greater than the cutoff indicating that those distributions are positively skewed where the scores are "clustered to the left at the low values" (Pallant, 2010:57). It was also revealed that, the z-scores of skewness test for R&D intensity and number of patents are slightly above the cutoff showing that the distributions are positively skewed. However, the z-scores of skewness test for all the key variables, i.e. DCs, exploratory capabilities, exploitative capabilities, market dynamism, the success trap and firm performance, did not exceed the cutoff ±3.29 whilst being slightly negatively skewed except the success trap distribution that was slightly positively skewed. More importantly, the z-scores of kurtosis test for all the above variables were not going beyond the cutoff ±3.29 whilst scores on firm size, firm age, marketing intensity, exploratory capabilities, exploitative capabilities, firm performance being rather peaked, i.e. 'clustered in the centre' and R&D intensity, number of patents, DCs, market dynamism and the success trap being relatively flat where there are "too many cases in the extremes" (Pallant, 2010:57). However, the skewness and kurtosis values for all the above variables are within the acceptable range recommended by Curran, West and Finch (1996) , i.e. skewness $< \pm 2$ and kurtosis $< \pm 7$.

The statistical test of normality further reveals that Kolmogorov-Smirnov (KS) statistic is significant ($p < 0.05$) for distribution of scores on firm size, firm age, R & D intensity, marketing intensity, number of patents, exploratory capabilities and the success trap suggesting violation of the assumption of normality ($p < 0.05$). On the other hand, distribution of scores on the constructs DCs, exploitative capabilities, market dynamism and firm performance met the assumption of normality, i.e. the scores on variable are normally distributed, reporting non-significant results in Kolmogorov-Smirnov (KS) statistic in normality test ($p > 0.05$) (Appendix 10). Thus, it can be concluded that overall the scores on all the constructs are fairly normally distributed. However, "many scales and measures used in the social sciences have scores that are skewed, either positively or negatively" (Pallant, 2010:64).

Homoscedasticity

Homoscedasticity is an assumption tested using ungrouped continuous data. "The assumption of homoscedasticity is that the variability in scores for one continuous variable is roughly the same at all values of another continuous variable" (Tabachnick and Fidell, 2007:85).

Homoscedasticity is desirable because the variance of the dependent variable being explained in the dependence relationship should not be concentrated in only a limited range of the dependent values (Hair et al., 1998:73). Bivariate scatter plots were used to test if the relationships between key variables are homoscedastic (Appendix 10). It was observed that the bivariate scatter plots between two variables are of roughly the same and some bulging toward the middle. As it was mentioned above, almost all the key variables are reasonably normally distributed resulting in a good level of homoscedasticity.

Multicollinearity

Multicollinearity is a problem caused by variables that are too highly correlated (0.90 and above) (Hair et al., 1998; Tabachnick and Fidell, 2007). In the preliminary analysis of data multicollinearity was tested by scanning the bivariate correlations matrix of the key constructs of the study (Appendix 10). No correlations of 0.90 or above were detected. Furthermore, multicollinearity was tested using variance inflation factor (VIF) in performing the regression analysis for hypothesis testing.

4.11. Profile of the Respondent Firms

Based on the responses to the questions on firm profile, the general profile of the firms in the usable sample of respondents who took part in the research is presented in this section. This includes data on firm size, firm age and the industry type in which the firm operates. In addition, the general profile of the individual respondents who represented participating firms is also presented.

Firm Size and Firm Age

Number of employees (e.g. Atuahene-Gima, 2005; Keeble et al., 1998; Yasuda, 2005) and the amount of reported capital (e.g. Chen, 2004) are the main measures of firm size found in the literature. In this study, firm size was measured using the number of employees in the firm and the respondents were given eight classes of number of employees in the firm and were asked to tick the relevant class. As mentioned earlier, following the European Commission's (2005) definition, the respondent high-tech SMEs were grouped into three categories: micro (less than 10 employees), small firms (10-less than 50 employees), and medium (50-less than 250 employees). The results reveal that 20.4% of the respondent firms were micro, 39.8% were small and the remaining 39.8% were medium sized firms. The sample represents more small and medium sized firms and less micro firms (Table 4.18).

It should be noted here that due to the decrease of employees over the last three years (2008, 2009 and 2010), the firms that reported less than 10 employees by the end of the survey but who had 10-249 employees at the time of drawing the sample, were also included in the effective sample provided that the questionnaires were complete. Change in the number of employees was used as an indicator of firm performance in this study. Furthermore, following He and Wong (2004) and many other researchers in strategic management and entrepreneurship, firms who have performance for a minimum of three years was taken in to consideration in this study. For example, in the UK SMEs context, Clifton et al. (2010) measured SME performance by turnover and employment during the three years prior to the survey.

Table 4.18. Distribution of Firms by Firm Size

Firm Size	Frequency	Percentage
Micro (Less than 10 employees)	23	20.4
Small (10-Less than 50 employees)	45	39.8
Medium (50-Less than 250 employees)	45	39.8
TOTAL	**113**	**100**

Firm age was calculated as of year 2010 based on the firm's year of incorporation provided by the respondents in the questionnaire. As presented in Table 4.19, Adult firms were representing 35.4% being the largest group in the sample and old firms were the next largest group (33.6%). Furthermore, 16.8% of the firms in the sample were new firms and another 14.2 % were young firms. Thus, among the sample of 113, majority were incorporated 11 or more years ago.

As expected, there was a clear pattern of relationship between firm age and size as it can be seen in Table 4.20 which shows that majority of the new firms were micro and majority of the young and adult firms were small and majority of the old firms were medium sized firms. Moreover, there was a significant positive correlation between firm age and firm size (Appendix 10). Overall, the above analysis indicates that the majority of UK high-tech firm are small or medium in size (employees 10 or above) and the majority UK high-tech firms have been in business for over 10 years.

Table 4.19. Distribution of Firms by Firm Age

Firm age	Frequency	Percentage
New (3-less than 6 years)	19	16.8
Young (6-10 years)	16	14.2
Adult (11-25 years)	40	35.4
Old (Over 25 years)	38	33.6
TOTAL	**113**	**100**

Table 4.20. Firm Size vs. Firm Age Crosstabulation

		Firm Age				
		New	Young	Adult	Old	Total
Firm Size	Micro	13(72.22%)	5(31.25%)	5(12.20%)	0(0.0%)	23(20.4%)
	Small	4(22.22%)	9(56.25%)	21(51.22%)	11(28.95%)	45(39.8%)
	Medium	1(5.56%)	2(12.50%)	15(36.60%)	27(71.05%)	45(39.8%)
Total		18(100%)	16(100%)	41(100%)	38(100%)	113(100%)

Industry type

The sample of firms was comprised of five types of hi-technology industries (OECD, 2003). As it can be seen in Table 4.21, the highest percentage of respondents were from the firms operating in the office and computing industry (31.9%) whereas the lowest percentage of respondents (9.7%) were from the firms operating in the pharmaceutical and biotech industry. Radio, TV and communication (22.1%) and medical and optical equipment industry (22.1%) represent the second largest groups of respondents while 14.2% consists of aerospace firms out of the 113 firms.

Table 4.21. Distribution of Firms by Industry Type

Industry Type	Frequency	Percentage
Aerospace	16	14.16%
Pharmaceutical and Biotechnology	11	9.73%
Office and Computing	36	31.86%
Radio, TV and Communication	25	22.12%
Medical and Optical Equipment	25	22.12%
TOTAL	113	100.00%

4.12. Summary

The chapter described the methodology and the methods adopted in the study. Satisfying the need for adopting both qualitative and quantitative methods in this kind of studies, both types of methods were adopted. The chapter discussed the research philosophy, the research approach, the research setting, the research design, quantitative data collection and analysis, qualitative data collection and analysis, triangulation, common method variance, preliminary results and data screening, and the profile of the respondent firms.

Chapter 5: Quantitative Data Analysis and Findings

5.1. Introduction

This chapter reports the quantitative data analysis and findings of the study. The chapter starts with a preliminary exploratory analysis of data and moves on to refining the scales used to measure the key constructs employing exploratory factor analysis. The next section deals with hypotheses testing using correlation analysis and regression analysis and the chapter concludes.

5.2. Exploratory Data Analysis

An exploratory data analysis was carried out in this section to understand the nature of the variables of the study. This involves analysis of descriptive statistics, correlations and cross-tabs and analysis of variance (ANOVA) for the key continuous variables.

5.2.1. Descriptive Statistics of the Key Constructs

The descriptive statistics were obtained for the key constructs and all 113 respondents have provided information on those variables. As presented in Table 5.1, the likelihood of firms falling into the success trap is at a moderate level as shown by the mean score of 3.67 out of 7.00. The success trap reported the lowest mean value among the key constructs. As indicated by the mean score of 4.03 out of 7.00, the firms are operating in a moderately dynamic market environment. As far as the level of DCs is concerned, the mean score is 5.36 out of 7.00 representing a high level of DCs of the firms. This is the highest mean value reported among the key constructs. The lower mean value for the success trap above is consonant with the higher mean value for DCs. Furthermore, the firms reported a moderate level of exploratory capabilities with a mean score of 4.37 out of 7.00 and, on the other hand, a fairly high level of exploitative capabilities where the mean score is 5.00 out of 7.00. When it comes to firm performance, a mean score of 4.44 out of 7.00 was reported indicating a moderate level of performance among the firms in the sample. As discussed in Chapter 4, overall the scores on all the key variables are fairly normally distributed. The z-scores of Skewness test and Kurtosis test (Appendix 10) for all the key variables, i.e. DCs, exploratory capabilities, exploitative capabilities, the success trap, market dynamism and firm performance, did not exceed the cutoff ±3.29 while being slightly negatively skewed apart from the success trap distribution that was slightly positively skewed. Other than scores on

exploratory capabilities and the success trap that reported significant Kolmogorov-Smirnov statistic ($p < 0.05$) suggesting violation of the assumption of normality, the statistical test of normality further reveals that distribution of scores on DCs, exploitative capabilities, market dynamism and firm performance met the assumption of normality, i.e. the scores on variables are normally distributed, reporting non-significant results in Kolmogorov-Smirnov statistic in normality test ($p > 0.05$).

Table 5.1. Descriptive Statistics of the Key Constructs

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	*Statistic*	*Statistic*	*Statistic*	*Statistic*	*Statistic*	*Std. Error*	*Statistic*	*Std. Error*
The Success Trap	113	1.90	5.60	3.67	0.79	0.27	0.23	-0.41	0.45
Market Dynamism	113	2.00	6.33	4.03	0.91	-0.07	0.23	-0.43	0.45
Dynamic Capabilities	113	3.09	7.00	5.36	0.88	-0.50	0.23	-0.16	0.45
Exploratory Capabilities	113	1.20	6.60	4.37	1.17	-0.66	0.23	0.03	0.45
Exploitative Capabilities	113	2.40	7.00	5.00	0.85	-0.15	0.23	0.06	0.45
Firm Performance	113	1.50	6.25	4.44	0.99	-0.48	0.23	0.36	0.45
Valid N (listwise)	113								

Note: 7-point Likert scales from1= "strongly disagree" to 7= "strongly agree" were used.

5.2.2. One Way ANOVA for the Key Constructs

A one way analysis of variance (ANOVA) was conducted to explore the impact of firm size, firm age and industry type on key constructs, i.e. the success trap, market dynamism, DCs, exploratory capabilities, exploitative capabilities and firm performance. The significance value (Sig.) for Levene's test is greater than 0.05 ($p > 0.05$) for all the key constructs indicating that the assumption of homogeneity of variance has been met (Appendix 13). This means that the variance in scores is not significantly different for each of the three firm sizes, four firm age groups, and five industry types. This is substantiated by the ANOVA results (Table 5.2) where, except for firm size versus firm performance, the scores for the key constructs among three firm sizes, four firm age groups, and five industry types are not significantly different (all the Sig. values are greater than 0.05, i.e. $p > 0.05$).This is further supported by the very small difference in mean scores between the groups (Appendix 13). In a further examination of the multiple comparisons for the ANOVA for firm size versus firm performance (Appendix 13) to identify where the exact difference was, it was found that small firms reported a higher mean performance score than that of the micro firms and the mean difference was statistically significant ($p = 0.04$).

Since there was a statistically significant difference, in order to assess the degree to which firm size and firm performance are associated with each other, the effect size was calculated.

"Effect size reflects the proportion of variance in the DV that is associated with levels of an IV…Statistical significance testing assesses the *reliability* of the association between the IV and DV. Effect size measures how much association there is" (Tabachnick and Fidell, 2007: 54). Out of the most commonly used effect size statistics, i.e. *partial eta squared* and *Cohen's d*, effect size was calculated using *partial eta squared* statistics which "indicate the proportion of variance of the dependent variable that is explained by the independent variable" (Pallant, 2010:210). Accordingly, the eta squared value was 0.06 for firm size versus firm performance which was a medium effect in terms of Cohen (1988: 284-287) where Cohen classifies 0.01 = a small effect, 0.06 = a medium effect, 0.14 = a large effect.

Table 5.2. One Way ANOVA for the Key Constructs

	Firm Size vs. Key Continuous Variables		Firm Age vs. Key Continuous Variables		Industry Type vs. Key Continuous Variables	
	F	*Sig.*	F	*Sig.*	F	*Sig.*
Market Dynamism	0.04	0.97	1.37	0.26	1.34	0.26
The Success Trap	1.42	0.25	0.91	0.44	1.43	0.23
Dynamic Capabilities	1.81	0.17	1.42	0.24	1.49	0.21
Exploratory Capabilities	1.45	0.24	0.73	0.54	1.40	0.24
Exploitative Capabilities	1.58	0.21	0.89	0.45	0.76	0.56
Firm Performance	3.81	0.03	0.35	0.79	1.44	0.23

NOTE: Firm size: micro (1-9 employees); small (10-49 employees); and medium (50-249 employees). Firm Age: new (3-less than 6 years); young (6-10 years); adult (11-25 years); and old (over 25 years). Industry Type: aerospace; pharmaceutical and biotechnology; office and computing; radio, TV and communication; medical and optical equipment.

5.3. Factor Analysis

Factor analysis plays a unique role in the application of other multivariate techniques such as hierarchical regression (Hair et al., 1998). Therefore, the data on scale items measuring key variables were subjected to factor analysis to "identify the separate dimensions of the structure and then determine the extent to which each variable is explained by each dimension" (Hair et al., 1998:90). There are two main approaches to factor analysis (Pallant, 2010): exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). Exploratory factor analysis is used in searching for structure among a set of variables or as a data reduction method whereas confirmatory factor analysis is used in testing hypotheses or theories (Pallant, 2010; Hair et al., 1998). Although, as suggested by Pallant (2010), both approaches often produce similar results, EFA is considered as psychometrically sound and mathematically simpler as compared with CFA (Stevens, 1996). EFA is also recommended when researcher simply wants to have an empirical summary of the dataset (Tabachnick and Fidell, 2007). More importantly, as one of the objectives of this research is operationalising and developing measures for new constructs such as DCs and the success trap whose

components have not been empirically tested, use of EFA is more appropriate (Stevens, 1996). Thus, considering the above benefits and the purpose of developing and testing new scales, EFA was employed in this study.

5.3.1. Appropriateness of the Data Set for Factor Analysis

The sample size and the strength of the relationship among the variables prove that the data set of this research is appropriate for factor analysis. First, the dataset meets the required sample size. There is very little agreement in the literature on the sample size required for factor analysis (Pett, Lackey and Sullivan, 2003), and the sample size recommended by researchers has decreased over the years (Stevens, 1996). Under some circumstances, even 50-100 cases are sufficient for factor analysis (Sapnas and Zeller, 2002). However, the required sample size can depend on the magnitude of population correlation and number of factors (Tabachnick and Fidell, 2007). As far as other criteria are concerned, it is not the overall sample size that matters, rather, the ratio of observations to items to be analysed. For example Nunnally (1978) suggests 10 to 1 ratio whereas others suggest 6 to 1 ratio (Guadagnoli and Velicer, 1988; Hinkins, 1998). Hair et al. (1998) suggest as a general rule to have at least 5 times as many observations (cases) as there are items to be analysed. In this study, the ratio that is above 10 cases to 1 item on each scale that has been used to measure the constructs, and the availability of 113 cases, i.e. more than five times the number of items to be analysed, confirm the suitability of the dataset for factor analysis. In addition to that, while acknowledging the fact that the sample size of the research is relatively low according to Comrey and Lee's (1992) guide, factor loadings above 0.50 that is considered practically significant for the sample size 100 or larger (Hair et al., 1998) are considered in extracting factors that would justify the adequacy of the sample size for factor analysis (Guadagnoli and Velicer, 1988). Furthermore, the results of the Kaiser-Meyer-Olkin (KMO) test that measures sampling adequacy (Kaiser, 1970 and 1974) also confirm the appropriateness of the sample size for factor analysis (Table 5.3); except for firm performance which is very close to 0.60, the KMO values are 0.60 or above for all the key constructs and this meets and exceeds the minimum value suggested by Tabachnick and Fidel (2007). Therefore, having sample size of 113 cases, this dataset meets the requirements for conducting factor analysis.

Second, taking the strength of the relationship among the variables in consideration, the factorability of data was assessed by Bartlet's test of sphericity (Bartlett, 1954). As shown in Table 5.3, Bartlett's Test of Sphericity is significant at $p < 0.001$ for all the key constructs and

this indicates the presence of correlations among the variables. In addition, the examination of correlation matrices of the items within each of the key constructs revealed that majority of the coefficients were greater than 0.30 (Tabachnick and Fidell, 2007). Thus, the above results confirm the appropriateness of the dataset for factor analysis.

Table 5.3. The Strength of Intercorrelations among the Variables

Variable	Kaiser-Meyer-Olkin Measure (KMO)	Bartlett's Test of Sphericity
Market Dynamism	0.69	*F*=137.66, *df*=15, *p*=0.000
The Success Trap	0.69	*F*=134.99, *df*=15, *p*=0.000
Dynamic Capabilities	0.86	*F*=822.36, *df*=45, *p*=0.000
Exploratory Capabilities	0.67	*F*=112.19, *df*=10, *p*=0.000
Exploitative Capabilities	0.76	*F*=173.46, *df*=10, *p*=0.000
Firm Performance	0.58	*F*=132.16, *df*=6, *p*=0.000

5.3.2. Extraction of Factors

Exploratory Factor Analysis was carried out using SPSS version 19 to extract the factors for each construct being measured in this study: market dynamism, the success trap, DCs, exploratory capabilities, exploitative capabilities and firm performance. Except in cases where it does not make any theoretical sense, factors are extracted based on Kaiser's criterion (Pallant, 2010) where only factors with an eigenvalue of 1.00 or more are retained (Nunnally, 1978; Stratub, 1989). Catell's (1966) Scree test is also used to determine the number of factors to be retained. The extracted factors were rotated to improve their interpretability and use. Out of the two main rotation methods that are discussed in the literature, i.e. orthogonal rotations and oblique rotations, the orthogonal technique of varimax was used[1].

The Success Trap

Based on Levinthal and March's (1993) conceptualisation of the success trap and Ahuja and Lampert's (2001) clarification of the key essence of the success trap in terms of how firms can be trapped by familiarity, maturity and propinquity, a 6-item scale to measure the success trap (ST) was developed and empirically tested. Based on survey data, the items were

[1] Varimax, quartimax and equamax are three orthogonal techniques (Tabachnick and Fidell, 2007). Having considered the easiness of interpretation of orthogonal rotations (Tabachnick and Fidell, 2007) and the less developed nature and considerable controversy associated with oblique rotations (Hair et al., 1998), the orthogonal technique varimax is used to rotate in this study. The use of varimax technique helps reducing the number of items to a meaningful set of item scales that measure the variables to be used in hierarchical regression analysis presented in this chapter. Hair et al. (1998) recommend orthogonal solution as the best for this purpose.

subjected to EFA and as presented in Table 5.4, it resulted in two components with eigenvalues greater than 1 that explains 59.09% of the total variance.

Table 5.4. Total Variance Explained: The Success Trap (Initial)

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.52	41.93	41.93	2.53	41.93	41.93	2.09	34.75	34.75
2	1.03	17.16	59.09	1.03	17.16	59.09	1.46	24.34	59.09
3	0.92	15.38	74.47						
4	0.64	10.70	85.17						
5	0.54	8.97	94.14						
6	0.35	5.86	100.00						

NOTE: Extraction Method: Exploratory Factor Analysis.

An inspection of the scree plot (Figure 5.1) revealed a clear break after the second component. Communality values of the items in the success trap scale, as seen in Table 5.5, apart from ST6, are all above the cutoff of 0.45 (Tabachnick and Fidell, 2007). Majority of the items are above the cutoff of 0.50 (Hair et al., 1998).

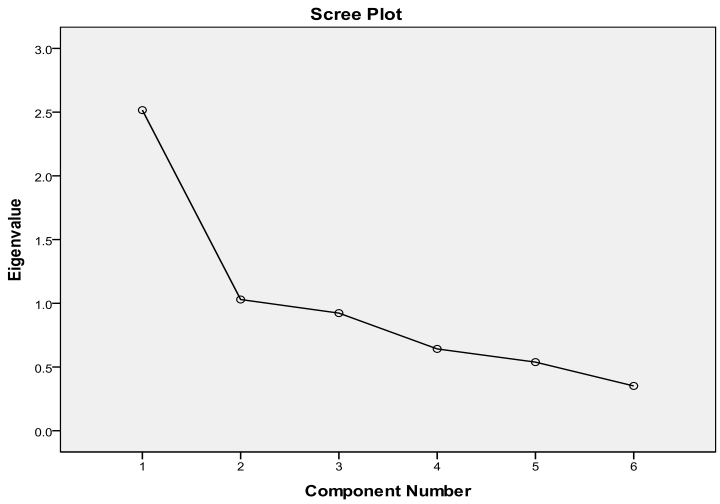


Figure 5.1. Scree Plot: The Success Trap

Having considered the moderate correlations (Appendix 12) among the items, the varimax rotation was used to rotate the items on each factor and factor loadings are above 0.45 (Table 5.6). Out of the two components shown in Table 5.6, the second component has two items, i.e. ST2 and ST6. The item ST2 that was supposed to measure the success trap characteristic related to the familiarity, had a strong factor loading of 0.91 which is extremely high (Hair et al., 1998). Therefore, ST2 was eliminated in the second round of the test. In addition, ST6

that was expected to measure the success trap characteristic related to the propinquity, also loaded on component two and reported a factor loading of 0.48. Considering the very low communality value of 0.30 (Table 5.5), ST6 was also eliminated in the second round of the test. As far as the two reverse-coded items are concerned, the reason for unusual result that both the items loaded on the same component could be respondents' misunderstanding of the questions. However, this was not evident in testing the questionnaire. It should also be noted here that items ST1 and ST5 reported cross loadings on both components and they were remained under the first component as they had relatively stronger loadings under that component.

Table 5.5. Communalities: The Success Trap

		Initial	Extraction
ST1	Rather than trying to move into new technologies, this firm has been relying on a set of familiar technologies	1.00	0.55
ST2	This firm has broken out its comfort zone of familiar technologies*.	1.00	0.83
ST3	This firm has been focussing on solving problems mainly through further development of mature technologies.	1.00	0.67
ST4	This firm prefers to adopt technologies which are well-established in the industry rather than untested technologies in the industry.	1.00	0.74
ST5	The tendency of this firm to look for solutions closer to existing technologies in the industry has been a barrier to develop pioneering solutions.	1.00	0.46
ST6	This firm has been looking for new technologies that are fundamentally different from existing technologies in the industry*.	1.00	0.30

NOTE: *A reverse-coded question that was re-coded for the analysis; Extraction Method: Exploratory Factor Analysis.

Table 5.6. Rotated Component Matrix[a] : The Success Trap (Initial)

		Component	
		1	2
ST1	Rather than trying to move into new technologies, this firm has been relying on a set of familiar technologies	0.58	0.46
ST2	This firm has broken out its comfort zone of familiar technologies*.		0.91
ST3	This firm has been focussing on solving problems mainly through further development of mature technologies.	0.82	
ST4	This firm prefers to adopt technologies which are well-established in the industry rather than untested technologies in the industry.	0.85	
ST5	The tendency of this firm to look for solutions closer to existing technologies in the industry has been a barrier to develop pioneering solutions.	0.53	0.42
ST6	This firm has been looking for new technologies that are fundamentally different from existing technologies in the industry*.		0.48

NOTE: a.Extraction Method: Exploratory Factor Analysis; Rotation Method: Varimax with Kaiser Normalization; *A reverse-coded question that was re-coded for the analysis and eliminated in the second round of the test.

Table 5.8 shows the results of a final EFA of the success trap excluding items ST2 and ST6, and after rotating using varimax method. The factors were derived based on eigenvalues. All the items were loaded on one component and they have reported strong factor loadings exceeding the cutoff 0.50 (Hair et al., 1998). These items measure how firms could be caught in the success trap as a result of relying on familiar technologies (ST1) or mature technologies (ST3 and ST4) or looking for solutions that are close to existing technologies

(ST5) as described by Ahuja and Lampert (2001). Hence, items ST1, ST3, ST4 and ST5 are retained for the final analysis (Table 5.8). These items explain 56.44% of total variance (Table 5.7).

Table 5.7. Total Variance Explained: The Success Trap (Final)

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.26	56.44	56.44	2.26	56.44	56.44
2	0.70	17.44	73.88			
3	0.59	14.85	88.74			
4	0.45	11.27	100.00			

NOTE: Extraction Method: Exploratory Factor Analysis.

Table 5.8. Component Matrix[a] : The Success Trap (Final)

		Component
		1
ST1	Rather than trying to move into new technologies, this firm has been relying on a set of familiar technologies	0.74
ST3	This firm has been focussing on solving problems mainly through further development of mature technologies.	0.76
ST4	This firm prefers to adopt technologies which are well- established in the industry rather than untested technologies in the industry.	0.81
ST5	The tendency of this firm to look for solutions closer to existing technologies in the industry has been a barrier to develop pioneering solutions.	0.69

NOTE: Extraction Method: Exploratory Factor Analysis; a.1 components extracted. The solution cannot be rotated.

Market Dynamism

The 6 items of the market dynamism scale were subjected to EFA and the first two components had eigenvalues greater than 1.00. In order to make sure that the measure captures all the aspects of the construct market dynamism, three factors were extracted. This would make the theoretical interpretation of the items clumped together on those factors more sensible. As mentioned in Chapter 4, the original 5-item scale developed by Atuahene-Gima (2005) based on Jaworski and Kohli (1993) that was adapted and used in this study covers the three important components of market dynamism construct, i.e. changes in *technology*, changes in *competition*, and changes in *customer*. The three components explain 73.59% of the total variance in the market dynamism constructs (Table 5.9).

An inspection of the scree plot (Figure 5.2) reveals a clear break after the third component that supports the decision to have three components above. Therefore, using Catell's (1966) scree test, it was decided to retain three components for further investigation. Communality values of the items in the market dynamism scale, as seen in Table 5.10, are all above the cutoff of 0.50 (Hair et al., 1998).

Table 5.9. Total Variance Explained: Market Dynamism

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.56	42.91	42.91	2.58	42.91	42.91	1.50	25.03	25.03
2	1.07	17.82	60.73	1.07	17.82	60.73	1.48	24.67	49.70
3	0.77	12.86	73.59	0.77	12.86	73.59	1.43	23.89	73.59
4	0.71	11.86	85.46						
5	0.49	8.18	93.63						
6	0.38	6.37	100.00						

NOTE: Extraction Method: Exploratory Factor Analysis.

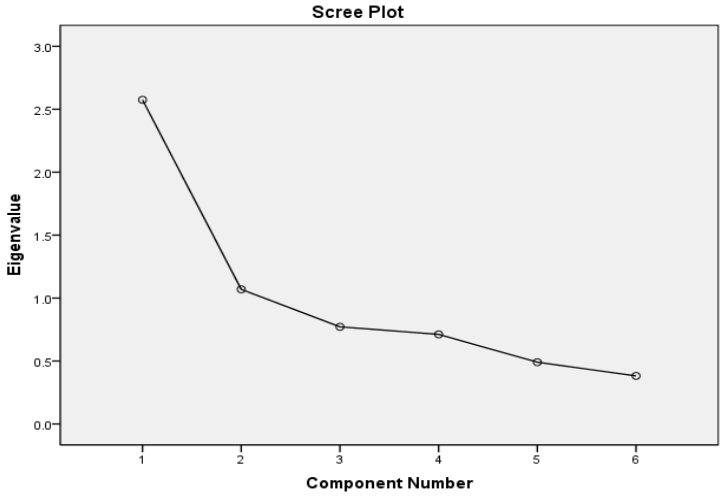


Figure 5.2. Scree Plot: Market Dynamism

Table 5.10. Communalities: Market Dynamism

		Initial	Extraction
MD1	The actions of local and foreign competitors in our major markets were changing quite rapidly	1.00	0.60
MD2	Technological changes in our industry were rapid	1.00	0.84
MD3	Technological changes in our industry were unpredictable.	1.00	0.61
MD4	The market competitive conditions were highly unpredictable.	1.00	0.84
MD5	Customers' product preferences changed quite rapidly.	1.00	0.73
MD6	Changes in customers' needs were quite unpredictable.	1.00	0.80

NOTE: Extraction Method: Exploratory Factor Analysis.

Given the moderate correlations (Appendix 12) among the items, the varimax rotation was used to rotate the items on each factor and resulted in factor loadings of above 0.50. This is considered significant for the sample size 100 or larger (Hair et al., 1998) as shown in the rotated component matrix (Table 5.11). As seen in Table 5.11, the construct of market dynamism consists of three components that can be labelled as (a) *rapidness of changes in technology and competition* (MD1 and MD2), (b) *unpredictability of changes in technology and competition* (MD3 and MD4), and (c) *uncertainty of customer behaviour* (MD5 and

MD6). All the items under each factor exceed the cutoff and they clearly measure the construct market dynamism.

The three factors respectively represent *rapidness*, *unpredictability* and *uncertainty* of changes in the market and, as a whole, they capture all three components (changes in technology, competition, and customer) of Atuahene-Gima's (2005:66) original measure of the construct market dynamism that was described as "market and technological changes that managers perceive as hostile and stressful conditions for their firm". The rapidness of changes in technology and competition refers to how fast the technology and competition in the industry change. Unpredictability of changes in technology and competition can be defined as the extent to which the changes in technology and competition can be forecast. Uncertainty of customer behaviour refers to the frequency of change in customers' needs and change in their preferences of products. Hence, all six items of the market dynamism scale were retained.

Table 5.11. Rotated Component Matrix[a] : Market Dynamism

		Component		
		1	2	3
MD1	The actions of local and foreign competitors in our major markets were changing quite rapidly.			0.62
MD2	Technological changes in our industry were rapid.			0.90
MD3	Technological changes in our industry were unpredictable.		0.68	
MD4	The market competitive conditions were highly unpredictable.		0.85	
MD5	Customers' product preferences changed quite rapidly.	0.77		
MD6	Changes in customers' needs were quite unpredictable.	0.87		

NOTE: Extraction Method: Exploratory Factor Analysis; Rotation Method: Varimax with Kaiser Normalization;
a. Rotation converged in 5 iterations.

Jaworski and Kohil (1993) used three different scales to measure the three environmental factors, i.e. market turbulence, competitive intensity and technological turbulence (Appendix 2). Atuahene-Gima (2005) adapted items representing all three factors above and developed his measure of environmental turbulence (Appendix 3) which can be considered as a unidimensional measure of market dynamism. The measure of market dynamism in this study was developed by adapting Atuahene-Gima's (2005) scale. The factor loadings of the initial EFA resulted in two components with eigenvalues greater than 1.00 and component one consisted of items MD3, MD4, MD5 and MD6 whereas component two included MD1 and MD2 (Appendix 14). Items MD3 and MD5 reported cross-loadings and the factor loadings on component one were stronger for both the items. In the initial EFA, the first component represented the rapidness in change in competition and technology and on the other hand, the

second component reflected the unpredictability of change in competition and technology, and change in customers. However, as mentioned above, the subsequent EFA resulted in three factors those make sense theoretically. Those three components include the *rapidness* of change in technology and competition, *unpredictability* in change in technology and competition, and the *uncertainty* in change in customers. This could be a result of respondents identifying the market dynamism in terms of the rapidness, unpredictability, and uncertainty of changes in market factors. The evidence in the literature substantiates the validity of the above three components of market dynamism. For example, in a review of related studies by Bstieler (2005), it was found that environmental uncertainty mostly reflected by unpredictability of, unfamiliarity with, or inability to understand technological or market related developments or changes. Furthermore, Miller and Friesen (1983:222) also identify the "rate of change and innovation in the industry as well as the uncertainty or unpredictability of the actions of competitors and customers as characteristics of dynamic environments".

Dynamic Capabilities

The EFA of the data on DCs scale resulted in two components with eigenvalues that are greater than 1 (Table 5.12) explaining 66.78% of the total variance. In addition, Catell's scree plot (Figure 5.3) also shows a clear break between the second and third components. Hence, two components are retained.

When the communalities are examined (Table 5.13), item DC4 has reported a factor loading of 0.26 which is below the minimum acceptable level 0.30 (Hair et al., 1998). Furthermore, the highest factor loading reported for item DC4 was 0.37 (Table 5.14), which was below the cutoff 0.50 (Hair et al., 1998). Therefore, item DC4 was dropped in the final round of factor analysis.

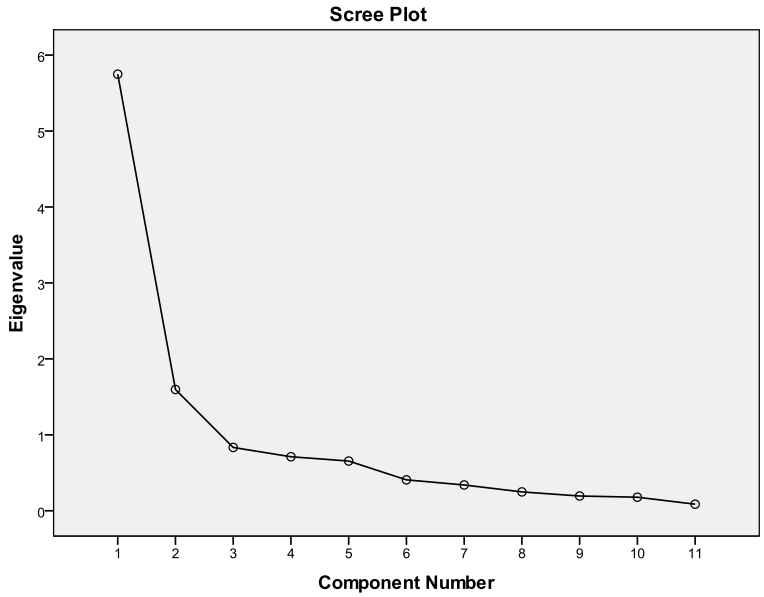


Figure 5.3. Scree Plot: Dynamic Capabilities

Table 5.12. Total Variance Explained: Dynamic Capabilities (Initial)

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.75	52.26	52.26	5.75	52.26	52.26	4.34	39.49	39.49
2	1.60	14.52	66.78	1.60	14.52	66.78	3.00	27.29	66.78
3	0.83	7.58	74.36						
4	0.71	6.47	80.83						
5	0.66	5.95	86.78						
6	0.41	3.70	90.48						
7	0.34	3.09	93.57						
8	0.25	2.26	95.82						
9	0.19	1.77	97.59						
10	0.18	1.62	99.21						
11	0.09	0.79	100.00						

NOTE: Extraction Method: Exploratory Factor Analysis.

Table 5.13. Communalities: Dynamic Capabilities

		Initial	Extraction
DC1	People in this firm are encouraged to challenge outmoded practices.	1.00	0.42
DC2	This firm is flexible enough to allow us to respond quickly to changes in our markets.	1.00	0.65
DC3	This firm evolves rapidly in response to shifts in our business priorities.	1.00	0.69
DC4	This firm has a clear division of roles and responsibilities for acquiring new knowledge.	1.00	0.26
DC5	This firm has the necessary skills to implement newly acquired knowledge.	1.00	0.84
DC6	This firm has the competences to transform the new acquired knowledge.	1.00	0.92
DC7	This firm has the competences to use the new acquired knowledge.	1.00	0.87
DC8	This firm introduces improvements and innovations in our business.	1.00	0.57
DC9	This firm is creative in its methods of operation.	1.00	0.69
DC10	This firm seeks out new ways of doing things.	1.00	0.79
DC11	People in this firm get a lot of support from managers if we want to try new ways of doing things.	1.00	0.65

NOTE: Extraction Method: Exploratory Factor Analysis.

Table 5.14. Rotated Component Matrix[a]: Dynamic Capabilities (Initial)

		Component	
		1	2
DC1	People in this firm are encouraged to challenge outmoded practices.	0.61	
DC2	This firm is flexible enough to allow us to respond quickly to changes in our markets.	0.73	
DC3	This firm evolves rapidly in response to shifts in our business priorities.	0.79	
DC4	This firm has a clear division of roles and responsibilities for acquiring new knowledge.*		0.37
DC5	This firm has the necessary skills to implement newly acquire knowledge.		0.88
DC6	This firm has the competences to transform the new acquired knowledge.		0.93
DC7	This firm has the competences to use the new acquired knowledge.		0.91
DC8	This firm introduces improvements and innovations in our business.	0.71	
DC9	This firm is creative in its methods of operation.	0.81	
DC10	This firm seeks out new ways of doing things.	0.87	
DC11	People in this firm get a lot of support from managers if we want to try new ways of doing things.	0.79	

NOTE: Extraction Method: Exploratory Factor Analysis; Rotation Method: Varimax with Kaiser Normalization; a. Rotation converged in 3 iterations; * Eliminated in the second round of the test.

As given in Table 5.14, the items were clearly loaded on two components and the factor loadings are above the cutoff 0.50 (Hair et al., 1998). The two components explain 71.29% of the total variance of the construct (Table 5.16). However, these components are quite different from the original classifications of the components of DCs (Teece, 2007) and not very different from those of Wang and Ahmed (2007). The final rotated component matrix reveals that adaptive and innovative capabilities load on a common component whereas items that measure absorptive capability clusters under a different component. The correlations (Appendix 12) among the items of the DCs scale are moderately strong and therefore, the varimax rotation method was used in rotating the factors.

The above components can be mainly identified under two main orientations of DCs of a firm: (1) *inward-looking,* for example, resource integration capabilities; resource reconfiguration capabilities (Eisenhardt and Martin, 2000), transformative capacity (Pandza and Holt, 2007), maintaining (transformational/reconfiguring) capability (Teece, 2007), adaptive capability and innovative capability (Wang and Ahmed, 2007) and (2) *outward-looking* , for example, resource gaining and releasing capabilities (Eisenhardt and Martin, 2000), absorptive capacity (Pandza and Holt, 2007), sensing capability and seizing capability (Teece, 2007), and absorptive capability (Wang and Ahmed, 2007).

Therefore, clearly distinguishing the inward-looking and outward-looking aspects of DCs and in light of the results of the EFA, the items are grouped under two component factors of the DCs construct. The new components are labeled as *absorptive capability* (items DC5, DC6, and DC7) and *transformative capability* (items DC1,DC2,DC3,DC8,DC9,DC10 and DC11). Pandza and Holt (2007:350) describe that the absorptive capability is "concerned with

exogenous technological change" and the transformative capability demonstrates "the capability to constantly redefine a portfolio of product or service opportunities based on knowledge endogenous to the firm". Furthermore, innovative capability has been identified as a transformative capability in the literature (e.g. Lawson and Samson, 2001). On the other hand, adaptive capability can be characterised by a firm's ability to process information (e.g. Chakravarthy, 1982), capacity to reconfigure activities within the firm (Gibson and Birkinshaw**,** 2004) etc. Therefore, these components measure the capability of firms in absorbing new knowledge and transforming that knowledge through adapting and innovating. Thus, the final scale of DCs consists of all the items on the original scale excluding item DC4.

Table 5.15. Rotated Component Matrix[a]: Dynamic Capabilities (Final)

		Component	
		1	2
DC1	People in this firm are encouraged to challenge outmoded practices.	0.61	
DC2	This firm is flexible enough to allow us to respond quickly to changes in our markets.	0.74	
DC3	This firm evolves rapidly in response to shifts in our business priorities.	0.79	
DC5	This firm has the necessary skills to implement newly acquired knowledge.		0.88
DC6	This firm has the competences to transform the new acquired knowledge.		0.94
DC7	This firm has the competences to use the new acquired knowledge.		0.91
DC8	This firm introduces improvements and innovations in our business.	0.71	
DC9	This firm is creative in its methods of operation.	0.81	
DC10	This firm seeks out new ways of doing things.	0.88	
DC11	People in this firm get a lot of support from managers if we want to try new ways of doing things.	0.79	

NOTE: a.Extraction Method: Exploratory Factor Analysis; Rotation Method: Varimax with Kaiser Normalization.

Table 5.16. Total Variance Explained: Dynamic Capabilities (Final)

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.54	55.38	55.38	5.54	55.38	55.38	4.29	42.88	42.88
2	1.59	15.91	71.29	1.60	15.91	71.29	2.84	28.41	71.29
3	0.72	7.20	78.49						
4	0.66	6.57	85.05						
5	0.42	4.21	89.27						
6	0.36	3.55	92.81						
7	0.26	2.58	95.40						
8	0.19	1.94	97.34						
9	0.18	1.79	99.13						
10	0.09	0.87	100.00						

NOTE: Extraction Method: Exploratory Factor Analysis.

Exploratory Capabilities

As given in Table 5.17, the EFA of data on the exploratory capabilities scale has resulted in one component that explains 46.58% of the total variance. This agrees with the theoretical

meaning of the construct (Atuahene-Gima, 2005; March 1991). In addition, Catell's scree plot (Figure 5.4) substantiates the existence of a single component that is significantly different from the rest that have reported eigenvalues lower than 1.

Table 5.17. Total Variance Explained: Exploratory Capabilities

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.33	46.58	46.58	2.33	46.58	46.58
2	0.99	19.67	66.24			
3	0.80	15.92	82.17			
4	0.49	9.79	91.95			
5	0.40	8.05	100.00			

NOTE: Extraction Method: Exploratory Factor Analysis.

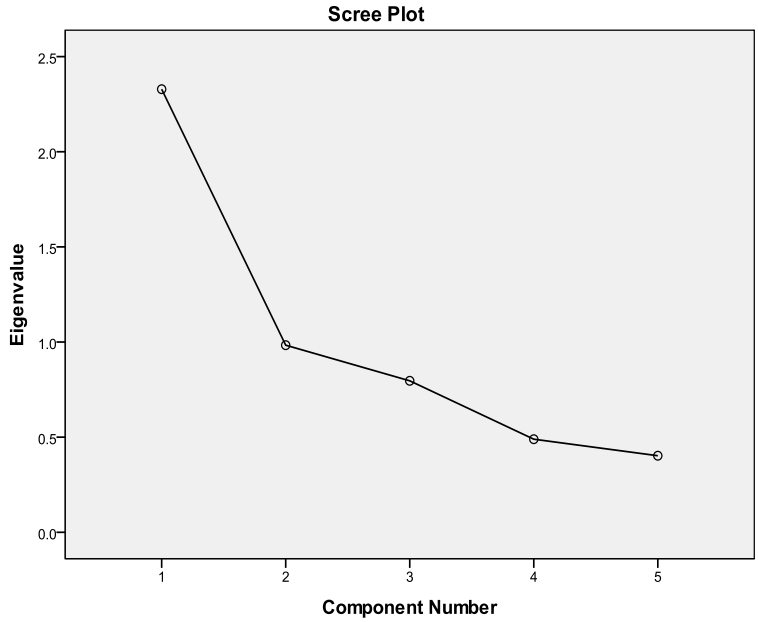


Figure 5.4. Scree Plot: Exploratory Capabilities

The rotated component matrix (varimax) of exploratory capabilities (Table 5.19) items presents factor loadings that are above the cutoff 0.50 recommended by Hair et al. (1998). The correlation matrix (Appendix 12) shows moderate correlation coefficients among the items of the exploratory capabilities scale. Even though the communality values of the items (Table 5.18) are relatively low, considering the high factor loadings and as it is an established measure that has been used in the past and has reported a relatively higher level of reliability[2], all five items were retained for further analysis.

[2] e.g. Atuahene-Gima (2005) reported a composite reliability of 0.83.Composite reliability (Fornell and Larcker, 1981) measures "reliability for the composite of measures of a latent variable" (Bagozzi and Yi, 1988: 80).

Table 5.18. Communalities: Exploratory Capabilities

		Initial	Extraction
EXPLOR1	Acquired manufacturing technologies and skills entirely new to the firm.	1.00	0.39
EXPLOR2	Learned product development skills and processes entirely new to the industry	1.00	0.42
EXPLOR3	Acquired entirely new managerial and organizational skills that are important for innovation?	1.00	0.45
EXPLOR4	Learned new skills in areas such as funding new technology, staffing R&D function, training and development of R&D, and engineering personnel for the first time.	1.00	0.57
EXPLOR5	Strengthened innovation skills in areas where it had no prior experience.	1.00	0.50

NOTE: Extraction Method: Exploratory Factor Analysis.

Table 5.19. Rotated Component Matrix[a]: Exploratory Capabilities

		Component
		1
EXPLOR1	Acquired manufacturing technologies and skills entirely new to the firm.	0.62
EXPLOR2	Learned product development skills and processes entirely new to the industry	0.65
EXPLOR3	Acquired entirely new managerial and organizational skills that are important for innovation?	0.67
EXPLOR4	Learned new skills in areas such as funding new technology, staffing R&D function, training and development of R&D, and engineering personnel for the first time.	0.76
EXPLOR5	Strengthened innovation skills in areas where it had no prior experience.	0.71

NOTE: Extraction Method: Exploratory Factor Analysis; a.1 component extracted.

Exploitative Capabilities

The EFA of the scores on the items measuring exploitative capabilities resulted in a single factor which has an eigenvalue greater than 1.00 (Table 5.20) and this factor explains 55.55% of the total variance in exploitative capabilities. Catell's scree plot (Figure 5.5) also reveals the same with a clear break between the first component and the second component. The communalities (Table 5.21) of all the items on the scale have reported values greater than 0.50 and strong factor loadings for all five items (Table 5.22). In addition, correlation coefficients (Appendix 12) among these items are also at a moderate to high level. Hence, all 5 items were considered for further analysis.

Table 5.20. Total Variance Explained: Exploitative Capabilities

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.78	55.55	55.55	2.78	55.55	55.55
2	0.85	16.96	72.51			
3	0.63	12.55	85.06			
4	0.40	8.02	93.08			
5	0.35	6.93	100.00			

NOTE: Extraction Method: Exploratory Factor Analysis.

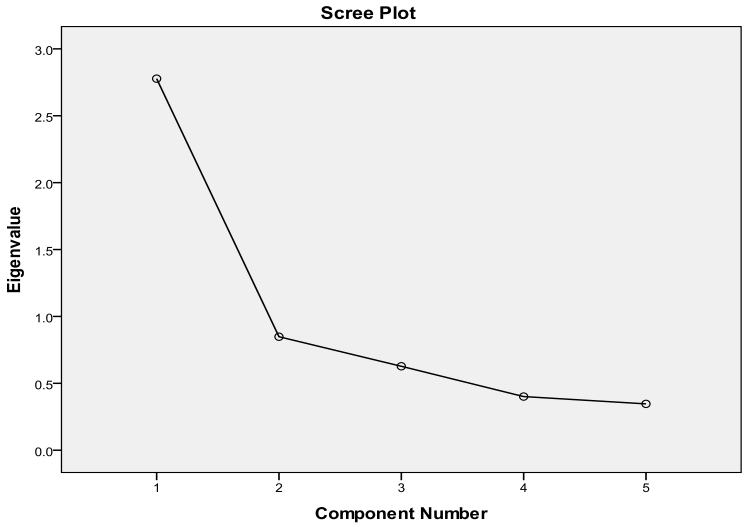


Figure 5.5. Scree Plot: Exploitative Capabilities

Table 5.21. Communalities: Exploitative Capabilities

		Initial	Extraction
EXPLOIT1	Upgraded current knowledge and skills for familiar products and technologies.	1.00	0.50
EXPLOIT2	Invested in enhancing skills in exploiting mature technologies that improve productivity of current innovation operations.	1.00	0.59
EXPLOIT3	Enhanced competencies in searching for solutions to customer problems that are near to existing solutions rather than completely new solutions.	1.00	0.55
EXPLOIT4	Upgraded skills in product development processes in which the firm already possesses significant experience.	1.00	0.52
EXPLOIT5	Strengthened its knowledge and skills for projects that improve efficiency of existing innovation activities.	1.00	0.62

NOTE: Extraction Method: Principal Component Analysis.

Table 5.22. Rotated Component Matrix[a]: Exploitative Capabilities

		Component
		1
EXPLOIT1	Upgraded current knowledge and skills for familiar products and technologies.	0.71
EXPLOIT2	Invested in enhancing skills in exploiting mature technologies that improve productivity of current innovation operations.	0.77
EXPLOIT3	Enhanced competencies in searching for solutions to customer problems that are near to existing solutions rather than completely new solutions.	0.74
EXPLOIT4	Upgraded skills in product development processes in which the firm already possesses significant experience.	0.72
EXPLOIT5	Strengthened its knowledge and skills for projects that improve efficiency of existing innovation activities.	0.79

NOTE: Extraction Method: Exploratory Factor Analysis: a.1 component extracted.

Firm Performance

Firm performance scale items were subjected to EFA where items loaded on two components with eigenvalues greater than 1.00 (Table 5.23) and those components are responsible for 82.41% of the total variance. In addition, the components are valid in theoretical sense as they represent financial indicators (Venkatraman and Ramanujam, 1986; Wu et al., 2006) and non-financial indicators of firm performance (Baum, Calabrese and Silverman, 2000; Morris et al., 2006).

Table 5.23. Total Variance Explained: Firm Performance

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.11	52.84	52.84	2.11	52.84	52.84	1.94	48.46	48.46
2	1.18	29.58	82.41	1.18	29.58	82.41	1.36	33.95	82.41
3	0.41	10.31	92.72						
4	0.29	7.28	100.00						

NOTE: Extraction Method: Exploratory Factor Analysis.

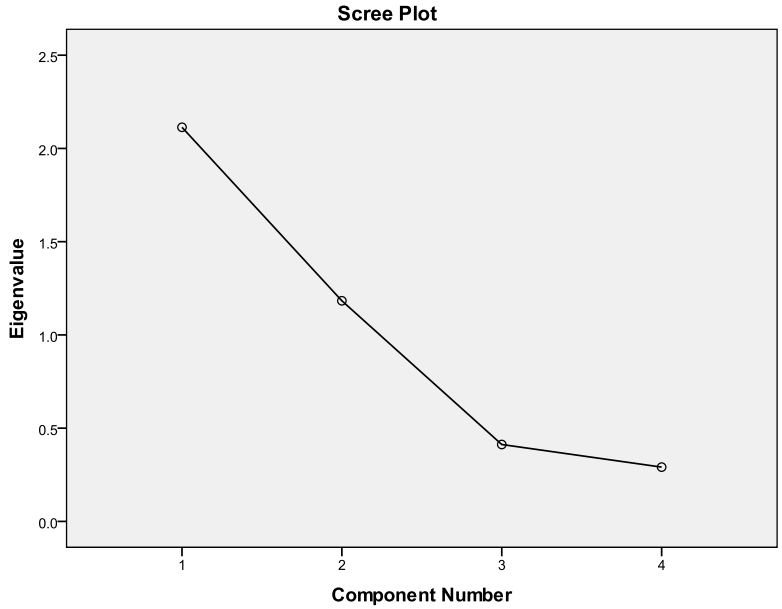


Figure 5.6. Scree Plot: Firm Performance

As seen in Figure 5.6, Catell's scree plot also clearly shows two main components. All the items on the scale have reported communalities values greater than 0.50 (Table 5.24). There are strong factor loadings for all they items under the two components those are greater than 0.50 (Table 5.25). In addition, the items within each component are considerably correlated (Appendix 12). Thus, the two components with all four items of firm performance were retained for further analysis.

Table 5.24. Communalities: Firm Performance

		Initial	Extraction
FP1	Sales growth	1.00	0.83
FP2	Growth in profitability	1.00	0.81
FP3	Increase in the number of employees	1.00	0.77
FP4	Increase in the size of business premises	1.00	0.88

NOTE: Extraction Method: Exploratory Factor Analysis.

Table 5.25. Rotated Component Matrix[a]: Firm Performance

		Component	
		1	2
FP1	Sales growth	0.91	
FP2	Growth in profitability	0.90	
FP3	Increase in the number of employees		0.69
FP4	Increase in the size of business premises		0.93

NOTE: Extraction Method: Exploratory Factor Analysis; Rotation Method: Varimax with Kaiser Normalization; a. Rotation converged in 3 iterations.

5.3.3. Reliability and Validity

Peter (1979:6) defines *reliability* as "the degree to which measures are free from error and therefore yield consistent results" and *validity* as "the degree to which instruments truly measure the constructs which they are intended to measure". Reliability is a necessary but not a sufficient condition for the validity of measures (Churchill, 1979; Peter, 1979). Reliability and validity are important conditions for theory development and testing (Parameswaran et al., 1979; Peter, 1981; Nunnally, 1978).

Three types of reliability can be found in the literature: (1) *stability* - This indicates if the measures have been stable over time (Bryman, 2004) and test re-test approach is used to check stability (Blumberg, Cooper and Schindler, 2008; Saunders, Lewis and Thornhill, 2000); (2) *internal consistency* - This can be used to evaluate consistency of responses which can be assessed by estimating the correlations of scores on items (Mitchel, 1996; Peter, 1979; Saunders, Lewis and Thornhill, 2000); and (3) *parallel form* - This is done by using two different tests (with different items) created using the same content that measure the same object and the tests are administered on the same subjects at the same time and then compare the results (Blumberg, Cooper and Schindler, 2008). In this research reliability was mainly measured by adopting established measures for the constructs that had reported Cronbach's Alpha of the cutoff 0.6 or above (Nunnally, 1978). In addition, as a non-statistical method, multi-item scales were used to maintain reliability.

The Cronbach's (1951) Alpha was calculated to test the *reliability* of the scales and in assessing the reliability of the overall scales, the cutoff 0.70 of Cronbach's Alpha coefficient recommended by Nunnally (1978) was applied. As recommended by Churchill (1979:68) "coefficient alpha *absolutely* should be the first measure one calculates to assess the quality of the instrument". Split-half reliability test that is used as another test of reliability of a construct has been criticised as the correlation between the scores of halves depends on the

way items are split into two halves [3](Brownell, 1933; Churchill, 1979; Kuder and Richardson, 1937). In addition, yet another test of reliability, the test-retest reliability has also been criticised because of the tendency of respondents to reply to an item in a second administration the same way they did in the first (Churchill, 1979).

Validity can be categorised in to four types:
(1) Face Validity – This is the superficial validity of the measures that can be assessed based on non-expert comments (Mitchell, 1966). Face validity was measured, as mentioned in Chapter 4, based on the comments by the PhD researchers of the School of Management, Royal Holloway, University of London (Saunders, Lewis and Thornhill, 2000).

(2) Content Validity – This indicates how much the items on the scale are representative of the construct being measured (Blumberg, Cooper and Schindler, 2008; Cronbach and Meehl, 1955; Saunders, Lewis and Thornhill, 2000). Content validity of the measures of this study was assessed, as mentioned in Chapter 4, based on the comments by an academic with the experience in the relevant area. This is mainly assessed based on ratings/comments by subject experts.

(3) Criterion Validity – This can be classified into two categories: *concurrent validity* and *predictive validity* (Cronbach and Meehl, 1955). Concurrent validity shows the extent to which the score resulted by the measure match the scores generated by a pre-existing measure when both measures are tested on the same subject independent of each other. Predictive validity indicates the extent of predictability of future by the measure (Neuman, 2003). This can be tested by comparing the score of a pre-existing measure, taken at a different time in future, with the score of the test measure (Bryman, 2004). In order to maintain the criterion validity of the measures, except the original measure for the success trap construct, this study adopted or adapted and used established measures to assess other constructs, i.e. *market dynamism* - Atuahene-Gima (2005), *dynamic capabilities* - Gibson and Birkinshaw (2004),

[3] "Some analysts mistakenly calculate split-half reliability to assess the internal homogeneity of the measure. That is, they divide the measure into two halves. The first half may be composed of all the even-numbered items, for example, and the second half all the odd-numbered items. The analyst then calculates a total score for each half and correlates these total scores across subjects. The problem with this approach is that the size of this correlation depends on the way the items are split to form the two halves. With, say, 10 items (a very small number for most measurements), there are 126 possible splits.2. Because each of these possible divisions will likely produce a different coefficient, what is the split-half reliability? Further, as the average of all of these coefficients equals coefficient alpha, why not calculate coefficient alpha in the first place?" (Churchill, 1979:69)

Garcia-Morales et al. (2008), Hughes and Morgan (2007), Wang and Ahmed (2004), *exploratory capabilities and exploitative capabilities* - Atuahene-Gima (2005), and *firm performance* – Baum, Calabrese and Silverman (2000), He and Wong (2004), Lumpkin and Des (2006), Morris et al. (2006), Robson and Bennett (2000), Wu et al., (2006).

(4) Construct validity – This is a key criterion of validity (Mitchell, 1996; Churchill, 1979). Peter (1981:134) describes construct validity as the "the vertical correspondence between a construct which is at an unobservable, conceptual level and a purported measure of it which is at an operational level. In an ideal sense, the term means that a measure assesses the magnitude and direction of (1) all of the characteristics and (2) only the characteristics of the construct it is purported to assess". In order to make sure that the measures meet the expected level of criterion validity and construct validity, as mentioned above, except for the success trap construct, established measured found in the literature were adopted or adapted and used this study taking the relevance of the research contexts where those measures had been originally used in to consideration.

Construct validity can be assessed along convergent validity and discriminant validity Convergent validity can be assessed based on the correlations between scores on the same construct obtained using different methods (Campbell and Fiske, 1959); this indicates the extent of convergence of different items on a scale that measures the same construct (Neuman, 2003). Discriminant validity ensures that the items on a scale that measures a construct are not highly correlated with the items that measure a different construct (Campbell, 1960; Churchill, 1979). This is an indicator of unidimensionality of a measure.

The convergent validity and discriminant validity were assessed in testing the construct validity (Churchill, 1979). The *convergent validity* was assessed by looking at correlation coefficients and by conducting exploratory factor analysis where factor loadings were examined. Accordingly, the test results show that, with regard to the convergent validity, the magnitude of factor loadings of individual items are above the cutoff 0.50 recommended by Hair et al. (1998). In addition, other than in exceptional cases that are explained, the total variance explained by the scales meet or exceeds the cutoff 50% (Merenda, 1997). The *discriminant validity* was also tested considering the correlations and employing exploratory factor analysis where it was made sure that there were no items highly loading on one component and at the same time highly loading on another component that was supposed to

measure a different construct (Ashill and Jobber, 2005; Emanuel and Bramble, 1989). Thus, the discriminant validity was verified by the examination of the distribution of factor loadings on each dimension of a construct.

In addition to assessing reliability and validity, the EFA results were used to confirm the unidimensionality of measures. Unidimensionality is described as the existence of one latent trait that is measured by all the items on a scale (Hattie, 1985). This can be a trait of each dimension of a construct or one trait of the whole construct in cases where there are no multiple dimensions.

Reliability and Validity of the Success Trap Scale

As presented in Table 5.26, the final EFA of the data on the success trap scale items resulted in factor loadings on a single component that explains 56.45% of the total variance. The items that make the success trap scale reported factor loadings that range from 0.69 to 0.74. The loadings are well above the cutoff 0.50 (Hair et al., 1998) and confirm the convergent validity of the scale. Furthermore, the strong loadings uniquely on one factor suggests unidimensionality of the success traps scale. As far as the reliability of the success traps scale is concerned, Cronbach's Apha coefficient of 0.74 shows a good level of internal consistency of the scale items.

Table 5.26. Reliability and Validity of the Success Trap Scale

Factors and Items		**Factor Loadings**	**Cronbach's Alpha**	**Variance Explained (%)**
ST1	Rather than trying to move into new technologies, this firm has been relying on a set of familiar technologies.	*0.74*		
ST3	This firm has been focussing on solving problems mainly through further development of mature technologies.	*0.76*		
ST4	This firm prefers to adopt technologies which are well-established in the industry rather than untested technologies in the industry.	*0.81*		
ST5	The tendency of this firm to look for solutions closer to existing technologies in the industry has been a barrier to develop pioneering solutions.	*0.69*		
Total Percentage of Variance				***56.45***
Overall Cronbach's Alpha			***0.74***	

Reliability and Validity of the Market Dynamism Scale

The EFA of the data on market dynamism scale items resulted in factor loadings on the three components requested by the researcher, and those on individual items that make up each

component are presented in Table 5.27. The three components explain 73.60% of the total variance. Uncertainty in customer behavior factor accounts for 42.9% of the total variance of the items with factor loadings ranging from 0.77 to 0.87. Unpredictability in change in technology and competition accounted for 17.8% which contained items with factor loadings ranging from 0.68 and 0.85. Rapidness in change in technology and competition accounted for 12.9% of the total variance and that contained items with factor loadings ranging from 0.62 to 0.90. The loadings are well above the cutoff 0.50 (Hair et al., 1998) and confirm the convergent validity of the scale. Furthermore, the fact that all items consistently loading on the three factors extracted and not significantly loading on a second factor while having strong loadings on one factor (Table 5.6) confirms the discriminant validity of the scale.

In addition, the market dynamism scale shows a good level of reliability with an overall Cronbach's Apha coefficient reported of 0.73.

Table 5.27. Reliability and Validity of the Market Dynamism Scale

Factors and Items		Factor Loadings	Cronbach's Alpha	Variance Explained (%)
Uncertainty in Customer Behaviour			*0.65*	*42.9*
MD5	*Customers' product preferences changed quite rapidly.*	*0.77*		
MD6	*Changes in customers' needs were quite unpredictable.*	*0.87*		
Unpredictability in Change in Technology and Competition			*0.59*	*17.8*
MD3	*Technological changes in our industry were unpredictable.*	*0.68*		
MD4	*The market competitive conditions were highly unpredictable.*	*0.85*		
Rapidness in Change in Technology and Competition			*0.55*	*12.9*
MD1	*The actions of local and foreign competitors in our major markets were changing quite rapidly.*	*0.62*		
MD2	*Technological changes in our industry were rapid.*	*0.90*		
Total Percentage of Variance				***73.60***
Overall Cronbach's Alpha			***0.73***	

Reliability and Validity of the Dynamic Capabilities Scale

As given in Table 5.28, the final EFA of the data on DCs scale items resulted in factor loadings on two components that explain 71.29% of the total variance. Transformative capability factor accounts for 55.38% of the total variance with factor loadings of the items that make up the dimension ranging from 0.61 to 0.88 whereas absorptive capability accounted for 15.91% that contained items with factor loadings ranging from 0.88 and 0.91. The loadings are well above the cutoff 0.50 (Hair et al., 1998) and provide sufficient evidence to confirm the convergent validity of the scale being 0.61 the weakest factor loading reported. All the items under each component strongly and consistently loading only on one dimension

at a time and not significantly loading on a second dimension at the same time (Table 5.15) suggest the unidimensionality of DCs components and confirm the discriminant validity of the scale. As for the DCs scale, the overall Cronbach's Apha coefficient reported of 0.91 indicating higher level of internal consistency of the scale.

Table 5.28. Reliability and Validity of the Dynamic Capabilities Scale

Factors and Items		Factor Loadings	Cronbach's Alpha	Variance Explained (%)
Transformative Capability			*0.90*	*55.38*
DC1	*People in this firm are encouraged to challenge outmoded practices.*	*0.61*		
DC2	*This firm is flexible enough to allow us to respond quickly to changes in our markets.*	*0.74*		
DC3	*This firm evolves rapidly in response to shifts in our business priorities.*	*0.79*		
DC8	*This firm introduces improvements and innovations in our business.*	*0.71*		
DC9	*This firm is creative in its methods of operation.*	*0.81*		
DC10	*This firm seeks out new ways of doing things.*	*0.88*		
DC11	*People in this firm get a lot of support from managers if we want to try new ways of doing things.*	*0.79*		
Absorptive Capability			*0.93*	*15.91*
DC5	*This firm has the necessary skills to implement newly acquired knowledge.*	*0.88*		
DC6	*This firm has the competences to transform the new acquired knowledge.*	*0.94*		
DC7	*This firm has the competences to use the new acquired knowledge.*	*0.91*		
Total Percentage of Variance				***71.29***
Overall Cronbach's Alpha			***0.91***	

Reliability and Validity of the Exploratory Capabilities Scale

As depicted in Table 5.29, the EFA of the data on exploratory capabilities scale items generated factor loadings on a single component that explains 46.58% of the total variance. The individual items of exploratory capabilities reported of factor loadings that range from 0.62 to 0.76. The loadings are well above the cutoff 0.50 (Hair et al., 1998) and this confirms

Table 5.29. Reliability and Validity of the Exploratory Capabilities Scale

Factors and Items		Factor Loadings	Cronbach's Alpha	Variance Explained (%)
EXPLOR1	*Acquired manufacturing technologies and skills entirely new to the firm.*	*0.62*		
EXPLOR2	*Learned product development skills and processes entirely new to the industry.*	*0.65*		
EXPLOR3	*Acquired entirely new managerial and organizational skills that are important for innovation?*	*0.67*		
EXPLOR4	*Learned new skills in areas such as funding new technology, staffing R&D function, training and development of R&D, and engineering personnel for the first time.*	*0.76*		
EXPLOR5	*Strengthened innovation skills in areas where it had no prior experience.*	*0.71*		
Total Percentage of Variance				***46.58***
Overall Cronbach's Alpha			***0.70***	

the convergent validity of the scale. Unidimensionality could be confirmed by the fact that initially all items on the exploratory capabilities scale showing high loadings uniquely on one factor. As far as the reliability of the exploratory capabilities scale is concerned, Cronbach's Apha coefficient of 0.70 represents a good level of internal consistency of the scale items.

Reliability and Validity of the Exploitative Capabilities Scale

The EFA of the data on exploitative capabilities scale items resulted in factor loadings on a single component that explains 55.55% of the total variance (Table 5.30). The individual items of exploitative capabilities reported of factor loadings that range from 0.71 to 0.79. The loadings are well above the cutoff 0.50 (Hair et al., 1998) and this confirms the convergent validity of the scale. Unidimensionality could be confirmed by the fact that initially all items on the exploitative capabilities scale showing high loadings uniquely on one factor. As far as the reliability of the exploitative capabilities scale is concerned, Cronbach's Apha coefficient of 0.70 shows a high level of internal consistency of the scale items.

Table 5.30. Reliability and Validity of the Exploitative Capabilities Scale

Factors and Items		**Factor Loadings**	**Cronbach's Alpha**	**Variance Explained (%)**
EXPLOIT1	*Upgraded current knowledge and skills for familiar products and technologies.*	*0.71*		
EXPLOIT2	*Invested in enhancing skills in exploiting mature technologies that improve productivity of current innovation operations.*	*0.77*		
EXPLOIT3	*Enhanced competencies in searching for solutions to customer problems that are near to existing solutions rather than completely new solutions.*	*0.74*		
EXPLOIT4	*Upgraded skills in product development processes in which the firm already possesses significant experience.*	*0.72*		
EXPLOIT5	*Strengthened its knowledge and skills for projects that improve efficiency of existing innovation activities.*	*0.79*		
Total Percentage of Variance				***55.55***
Overall Cronbach's Alpha			***0.80***	

Reliability and Validity of the Firm Performance Scale

As presented in Table 5.31, the EFA of the data on firm performance scale items resulted in factor loadings on two components that explain 71.29% of the total variance. Financial performance factor accounts for 52.84% of the total variance with factor loadings of the items that make up the dimension ranging from 0.90 to 0.91 whereas non-financial performance accounted for 29.58% that contained items with factor loadings ranging from 0.69 and 0.93. The weakest factor loading being 0.69, all the loadings are well above the cutoff 0.50 (Hair et al., 1998) and that provide adequate evidence to confirm the convergent validity of the scale. All the items strongly and consistently loading only on one dimension at a time and not

significantly loading on a second dimension at the same time (Table 5.25) suggest the unidimensionality of each of the firm performance dimensions and confirm the discriminant validity of the scale.

The overall Cronbach's Apha coefficient reported of 0.68, i.e. almost 0.70 shows a good level of internal consistency of the firm performance scale.

Table 5.31. Reliability and Validity of the Firm Performance Scale

Factors and Items	Factor Loadings	Cronbach's Alpha	Variance Explained (%)
Financial Performance		*0.82*	*52.84*
FP1 Sales growth	0.91		
FP2 Growth in profitability	0.90		
Non-Financial Performance		*0.59*	*29.58*
FP3 Increase in the number of employees	0.69		
FP4 Increase in the size of business premises	0.93		
Total Percentage of Variance			***82.41***
Overall Cronbach's Alpha		***0.68***	

5.4. Hypotheses Testing

The research hypotheses of the study were tested mainly using regression analysis except H_5 that was tested using correlation analysis. The regression analysis is used to assess the relationship between one dependent variable (DV) and one or more independent variables (IVs). Three main types of regression types are found in the literature: standard multiple regression, hierarchical (sequential) regression and stepwise (statistical) regression. "Differences between these techniques involve the way variables enter the equation: what happens to variance shared by variable and who determines the order in which variables enter the equation" (Tabachnick and Fidell, 2007: 118). Using the scales that were refined through factor analysis, hierarchical regression analysis is employed in this study to test the hypotheses formulated in Chapter 3.

The hierarchical regression analysis is applicable to this study for several reasons. There is data available on more than one IV and one DV (Tabachnick and Fidell, 2007). The hierarchical regression gives the researcher the freedom to specify the order of entry of variables based on theoretical considerations of the study (Tabachnick and Fidell, 2007), and this method also gives the option to control the effect of selected variables that will highlight the effect of relevant IVs on the DV. More importantly, this study meets the requirements for multiple regression analysis that were set out by Hair et al. (1998): (1) using metric data or

appropriately transformed data in the study, and (2) the researcher is able to decide which variable is to be dependent and which variables will be independent.

5.4.1. Assumptions of (Hierarchical) Multiple Regression

Sample Size

Sample size plays a key role in multiple regression analysis as it is an issue of generalisability (Pallant, 2010). In determining the sample size, different guidelines can be found in the literature. Stevens (1996:72) recommends that about 15 participants per predictor are needed for a reliable equation. Tabchnick and Fidell (2007) suggest a formula for calculating sample size, i.e., $N > 50 + 8m$ (m = number of variables). For multiple regression analysis, the ratio of the number of observations to independent variables should not fall below five (Bartlett II, Kotrlik and Higgins, 2001:48). Otherwise, as pointed out by Hair et al. (1998:105), this will make "…the results too specific to the sample, thus lacking generalisability".

It should be noted here that each construct of this study consists of separate sets of variables, i.e. 6 variables for market dynamism, 4 variables for the success trap, 10 variables for DCs, 5 variables for exploratory capabilities, 5 variables for exploitative capabilities, and 4 variables for firm performance. In other words, the variables of the study have been aggregated into 6 key constructs. With five independent constructs in the research model, according to Tabachnick and Fidell's (2007) criteria, the sample size of this research should be 90, i.e. 50 + 8 * 5. If Steven's (1996) criteria are applied, the sample size should be 75, i.e. 15 * 5. Therefore, the sample size of 113 SMEs of this research is well above the requirements resulting in an observations to independent ratio of 22 (113/5) that is beyond the minimum requirement for using multiple regression analysis prescribed by Bartlett II, Kotrlik and Higgins (2001).

Multicollinearity

Multicolliniariy among independent variables was tested and no bivariate correlations greater than Tabchnick and Fidell's (2007) cutoff 0.70 (Table 5.32), which would result in multicollinearity, were detected.

Table 5.32. Bivariate Correlations

Variables	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
1. *Firm Size*	1.00										
2. *Firm Age*	0.54**	1.00									
3. *R & D Intensity*	-0.28**	-0.40**	1.00								
4. *Marketing Intensity*	-0.23*	-0.27**	0.44**	1.00							
5. *Number of Patents*	0.18	-0.01	0.39**	0.23*	1.00						
6. *Dynamic Capabilities*	-0.17	-0.23*	0.28**	0.12	0.10	1.00					
7. *Exploratory Capabilities*	0.13	0.07	0.21*	0.06	0.29**	0.50**	1.00				
8. *Exploitative Capabilities*	0.18	0.11	-0.03	-0.02	0.15	0.46**	0.49**	1.00			
9. *Market Dynamism*	-0.06	-0.13	0.10	0.03	0.05	0.03	0.10	0.08	1.00		
10. *The Success Trap*	0.07	0.22*	-0.51**	-0.26**	-0.28**	-0.58**	-0.43**	-0.21*	-0.04	1.00	
11. *Firm Performance*	0.00	0.03	-0.02	0.20*	-0.02	0.18	0.17	0.21*	-0.06	-0.08	1.00

NOTE:** Correlation is significant at the 0.01 level (2-tailed); * Correlation is significant at the 0.05 level (2-tailed).

Multicollinearity was further tested using *tolerance* ($1\text{-}R^2$) and *variance inflation factor* (VIF). "Tolerance is an indicator of how much of the variability of the specified independent [variable] is not explained by the other independent variables in the model" whereas "VIF is the inverse of tolerance value (1 divided by tolerance)" (Pallant, 2010:158). A tolerance value that is smaller than 0.10 and a VIF value that is greater than 10 indicate multicollinearity (Pallant, 2010; Neter, Wasserman and Kutner, 1985). Appendix 15 shows that all the tolerance levels are well above the recommended threshold of 0.10 (lowest = 0.518) and all the VIF values are smaller than the cutoff point 10 with 1.929 being the highest value.

Outliers

As pointed out by Pallant (2010), multiple regression analysis is very sensitive to (in this case multivariate) outliers. Tabchnick and Fidell (2007) suggest that both statistical and graphical methods can be used to detect multivariate outliers. Accordingly, in this study, multivariate outliers were searched using the *Mahalanobis distance* (*Mahalanobis* D^2) and standardized residual plots. As defined in Chapter 4, "Mahalanobis D^2 is a measure of the distance in multidimensional space of each observation from the mean center for the observation" (Hair et al., 1998:66).

First, prior to regression analysis, during the data screening process presented in Chapter 4, the Mahalanobis distance was computed for combinations of all the key continuous variables prior to the regression runs and the values were evaluated for each case using Chi-square (χ^2) distribution. Applying the probability estimate $p < 0.001$ for χ^2 value (Tabachnick and Fidell, 2007), no multivariate outliers were located indicating that combination of values on the key constructs did not result in any outliers.

Outliers were further screened through residual analysis after an initial regression run. This is because, "under some conditions, Mahalanobis distance can either 'mask' a real outlier (produce a false negative) or 'swamp' a normal case (produce a false positive). Thus it is not a perfect indicator of multivariate outliers and should be used with caution" (Tabachnick and Fidell, 2007:74). As presented in Figure 5.7, the standardized residual values are within the acceptable range ± 3.30 (Tabachnick and Fidell, 2007:128) which indicates the absence of outliers.

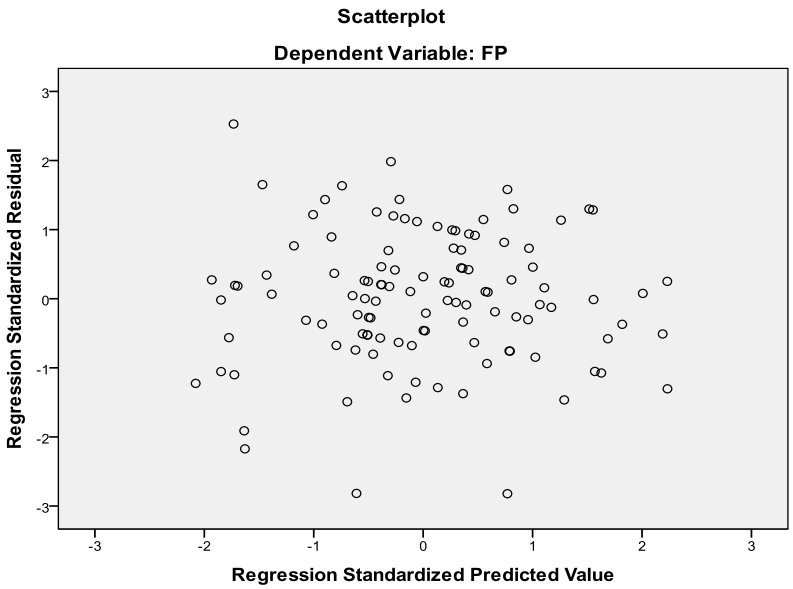


Figure 5.7. Residual Scatterplot

Normality, Linearity and Homoscedasticity

Normality, linearity and homoscedasticity were checked by examining the residual scatterplot (Figure 5.8) and normal probability plot (Figure 5.9) and it was found that all three assumptions are met (Tabachnick and Fidell, 2007). In the scatterplot, the residuals are roughly rectangularly distributed with most of the scores concentrated in the centre indicating that the assumptions of normality and linearity are met (Pallant, 2010; Tabachnick and Fidell, 2007). Furthermore, inspection of the normal probability plot reveals that all the points lie in a reasonably straight diagonal line from bottom left to right suggesting no major deviations from normality (Pallant, 2010). The assumption of homoscedasticity is also met as the standard deviations of errors of prediction are approximately equal for all the predicted dependent variable scores (Tabachnick and Fidell, 2007: 127). This can be seen in the scatterplot with the band enclosing the residual is approximately equal in width.

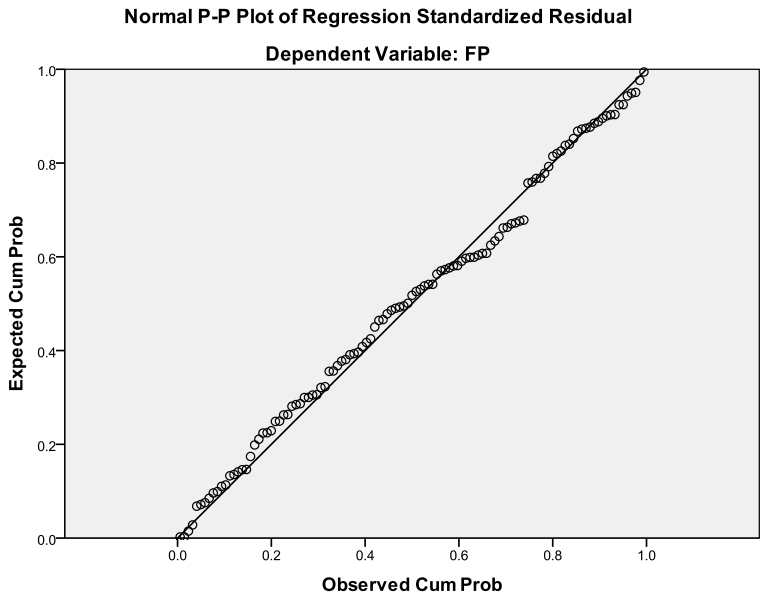


Figure 5.8. Normal P-P Plot

5.4.2. Results of Hierarchical Regression Analysis

The hierarchical regression analysis was employed to test the hypotheses H_1, H_2, H_3, H_4, H_6 and H_7 of the study and the analysis was performed in several steps. The control variables firm *size*, *firm age*, *R&D intensity*, *marketing intensity* and *numbers of patents* were entered in Step 1. Those variables were controlled to eliminate their possible effect on the dependent variables. The independent variables were entered in Step 2. Change in R^2 and the significance were examined to identify each independent variable's predictive power of the dependent variable.

The Success Trap and Dynamic Capabilities

Table 5.33 presents the results of the regression analysis of the success trap and DCs, after controlling for firm size, firm age, R&D intensity, marketing intensity and number of patents. Control variables were entered at Step 1, R^2 was 0.11 explaining 11% of the variance in DCs. R&D intensity was the only control variable that was significant in Model 1 with $\beta = 0.25$, $p = 0.05$. After entry of the success trap at Step 2, the total variance explained by the model as a whole was 20%, $F(6, 106) = 4.31$, $p = 0.001$. Thus, the independent variable success trap is a statistically significant predictor of DCs, after controlling for firm size, firm age, R&D intensity, marketing intensity and number of patens, R^2 change = 0.09, F change (1,106) = 11.38, $p = 0.001$ and with $\beta = -0.35$, $p = 0.001$.No control variable was statistically

significant in Model 2. These results support hypothesis (H_1) *The success trap has a negative influence on dynamic capabilities of firms.*

Table 5.33. Hierarchical Regression Analyses: The Effect of the Success Trap on Dynamic Capabilities

	Model 1		***Model 2***	
	Beta[a]	***t*-value**	**Beta[a]**	***t*-value**
(Constant)		22.03***		15.57***
Firm Size	-0.05	-0.44	-0.07	-0.63
Firm Age	-0.12	-1.03	-0.07	-0.64
R&D Intensity	0.25	2.13*	0.09	0.74
Marketing Intensity	-0.03	-0.28	-0.05	-0.48
Number of Patents	0.02	0.16	0.03	0.28
The Success Trap			-0.35	-3.37***
R^2		0.11		0.20
Adjusted R^2		0.07		0.15
F		2.64		4.31
F Change		2.64		11.38
R^2 Change		0.11		0.09

NOTE: [a] Standardized Coefficients; *$p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$; N= 113; *Firm Size* = the number of employees in the firm; *Firm Age* = the number of years a firm has been in operation since the date of establishment; *R&D Intensity* = how much money out of the sales revenue of a firm is spent on R&D; *Marketing Intensity* = how much money out of the sales revenue spent on marketing; and *Number of Patents* = number of patents owned by the firm.

Market Dynamism and Dynamic Capabilities

The results of the regression analysis of the relationship between market dynamism and DCs, after controlling for firm size, firm age, R&D intensity, marketing intensity and number of patens are presented in Table 5.34. Control variables were entered at Step 1, R^2 was 0.11 explaining 11% of the variance in DCs. R&D intensity was the only control variable that was significant in Model 1 with $\beta = 0.25$, $p = 0.05$. After entry of the market dynamism at Step 2, the total variance explained by the model as a whole was still 11%, $F(6, 106) = 2.18$, $p = 0.05$. The independent variable market dynamism explained only an additional 0.00 % of the variance in DCs, after controlling for firm size, firm age, R&D intensity, marketing intensity and number of patens, R^2 change = 0.00, F change (1,106) = 0.00, $p > 0.05$ indicating market dynamism is not a significant predictor of DCs of high-tech SMEs. Like in Model 1, in the final model, only R&D intensity was statistically significant with $\beta = 0.25$, and $p < 0.05$ confirming that R&D intensity can have a positive influence on DCs of a firm. These results

do not support hypothesis (H_2) *Market dynamism has a positive influence on dynamic capabilities of a firm.*

Table 5.34. Hierarchical Regression Analysis: The Effect of Market Dynamism on Dynamic Capabilities

	Model 1		***Model 2***	
	Beta[a]	***t*-value**	**Beta[a]**	***t*-value**
(Constant)		22.03***		11.44***
Firm Size	-0.05	-0.44	-0.05	-0.44
Firm Age	-0.12	-1.03	-0.12	-1.02
R&D Intensity	0.25	2.13*	0.25	2.12*
Marketing Intensity	-0.03	-0.28	-0.03	-0.28
Number of Patents	0.02	0.16	0.02	0.16
Market Dynamism			0.00	-0.03
R^2		0.11		0.11
Adjusted R^2		0.07		0.06
F		2.64		2.18
F Change		2.64		0.00
R^2 Change		0.11		0.00

NOTE: [a] Standardized Coefficients; *$p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; N= 113; *Firm Size* = the number of employees in the firm; *Firm Age* = the number of years a firm has been in operation since the date of establishment; *R&D Intensity* = how much money out of the sales revenue of a firm is spent on R&D; *Marketing Intensity* = how much money out of the sales revenue spent on marketing; and *Number of Patents* = number of patents owned by the firm.

Dynamic Capabilities and Entrepreneurial Capabilities

In testing the hypotheses on the relationship with DCs and entrepreneurial capabilities of exploration and exploitation, first, a preliminary test was carried out by examining the cross-tabulations of the constructs separately (Table 5.35 and Table 5.36). As it can be seen in Table 5.35, 79 firms have reported a high level of DCs which is 69.91% of the total sample. Out of those 79 firms, only 35.40% possess a high level of exploratory capabilities and the majority of high-tech firms with a high level of DCs have reported a moderate level of exploratory capabilities, i.e. 54.40% and the majority of the high-tech firms with a moderate level of DCs demonstrate a moderate level of exploratory capabilities. This indicates that having a high level of DCs does not necessarily mean that a firm possesses a high level of exploratory capabilities as well.

Table 5.35. Dynamic Capabilities vs. Exploratory Capabilities

		Dynamic Capabilities			
		Low	Moderate	High	Total
Exploratory Capabilities	Low	1(100%)	9(27.30%)	8(10.10%)	18(15.90%)
	Moderate	0(0.00%)	19(57.60%)	43(54.40%)	62(54.90%)
	High	0(0.00%)	5(15.20%)	28(35.40%)	33(29.20%)
Total		1(100%)	33(100%)	79(100%)	113(100%)

As far as DCs and exploitative capabilities are concerned, as presented in Table 5.36, out of the 79 high-tech firms with a high level of DCs, the majority, i.e. 55.70%, possesses a high level of exploitative capabilities. On the other hand, out of the 33 high-tech firms with a moderate level of DCs, 81.80% have reported a moderate level of exploitative capabilities as well. These data show that firms with a high level of DCs tend to have a high level of exploitative capabilities.

Table 5.36. Dynamic Capabilities vs. Exploitative Capabilities

		Dynamic Capabilities			
		Low	Moderate	High	Total
Exploitative Capabilities	Low	0(0.00%)	1(3.00%)	1(1.30%)	2(1.80%)
	Moderate	1(100%)	27(81.80%)	34(43.00%)	62(54.90%)
	High	0(0.00%)	5(15.20%)	44(55.70%)	49(43.40%)
Total		1(100%)	33(100%)	79(100%)	113(100%)

The influence of DCs on the above two main components of firm level entrepreneurial capabilities, exploratory capabilities an exploitative capabilities was tested next.

Dynamic Capabilities and Exploratory Capabilities

The results of the hierarchical regression analysis of DCs and exploratory capabilities, after controlling for firm size, firm age, R&D intensity, marketing intensity and number of patents are given in Table 5.37. The control variables were entered at Step 1, R^2 was 0.12 explaining 12% of the variance in exploratory capabilities. No control variable was a statistically significant predictor of exploratory capabilities in Model 1. After entry of the DCs at Step 2, the total variance explained by the model as a whole was 36%, F (6, 106) = 9.88, $p < 0.001$. Accordingly, the independent variable DCs is a statistically significant predictor of exploratory capabilities, after controlling for firm size, firm age, R&D intensity, marketing intensity and number of patents, R^2 change = 0.24, F change (1,106) = 39.29 $p < 0.001$ and with $\beta = 0.52$, $p < 0.001$. In addition, control variable number of patents was also statistically significant in Model 2 with $\beta = 0.18$, $p < 0.05$. This indicates that number of patents can be a positive indicator of exploratory capabilities of a firm. A firm's DCs are a significant

predictor of its exploratory capabilities and as a firm explores it tends to have more patents as a result of increased exploratory capabilities. These results support hypothesis (H_3) *Dynamic capabilities have a positive relationship with exploratory capabilities of firms.*

Table 5.37. Hierarchical Regression Analysis: The Effect of Dynamic Capabilities on Exploratory Capabilities

	Model 1		***Model 2***	
	Beta[a]	***t*-value**	**Beta[a]**	***t*-value**
(Constant)		12.48***		0.51***
Firm Size	0.10	0.87	0.12	1.28
Firm Age	0.10	0.88	0.16	1.64
R&D Intensity	0.22	1.92	0.10	0.93
Marketing Intensity	-0.04	-0.36	-0.02	-0.25
Number of Patents	0.19	1.83	0.18	2.04*
Dynamic Capabilities			0.52	6.27***
R^2		0.12		0.36
Adjusted R^2		0.08		0.32
F		2.94		9.88
F Change		2.94		39.29
R^2 Change		0.12		0.24

NOTE: [a] Standardized Coefficients; *$p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$; N= 113; *Firm Size* = the number of employees in the firm; *Firm Age* = the number of years a firm has been in operation since the date of establishment; *R&D Intensity* = how much money out of the sales revenue of a firm is spent on R&D; *Marketing Intensity* = how much money out of the sales revenue spent on marketing; and *Number of Patents* = number of patents owned by the firm.

Dynamic Capabilities and Exploitative Capabilities

Table 5.38 presents the results of the regression analysis of the influence of DCs on exploitative capabilities, after controlling for firm size, firm age, R&D intensity, marketing intensity and number of patents. Control variables were entered at Step 1, R^2 was 0.05 explaining 5% of the variance in exploitative capabilities. No control variable was a statistically significant predictor of exploitative capabilities in Model 1. After entry of the DCs at Step 2, the total variance explained by the model as a whole was 26%, F (6, 106) = 6.15, $p < 0.001$. The results reveal that the independent variable DCs is a statistically significant predictor of exploitative capabilities, after controlling for firm size, firm age, R&D intensity, marketing intensity and number of patens, R^2 change = 0.21, F change (1,106) = 29.98, $p < 0.001$ and with $\beta = 0.49$, $p < 0.001$. Like in Model 1, no control variable was statistically significant in Model 2. These results support hypothesis (H_4): *Dynamic capabilities have a positive relationship with exploitative capabilities of firms.*

Table 5.38. Hierarchical Regression Analysis: The Effect of Dynamic Capabilities on Exploitative Capabilities

	Model 1		***Model 2***	
	Beta[a]	***t*-value**	**Beta[a]**	***t*-value**
(Constant)		19.49***		4.38***
Firm Size	0.13	1.12	0.16	1.49
Firm Age	0.05	0.38	0.10	0.97
R&D Intensity	0.00	0.01	-0.12	-1.09
Marketing Intensity	0.01	0.12	0.03	0.28
Number of Patents	0.13	1.19	0.12	1.26
Dynamic Capabilities			0.49	5.48***
R^2		0.05		0.26
Adjusted R^2		0.00		0.22
F		1.09		6.15
F Change		1.09		29.98
R^2 Change		0.05		0.21

Note: [a] Standardized Coefficients; *$p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; N= 113; *Firm Size* = the number of employees in the firm; *Firm Age* = the number of years a firm has been in operation since the date of establishment; *R&D Intensity* = how much money out of the sales revenue of a firm is spent on R&D; *Marketing Intensity* = how much money out of the sales revenue spent on marketing; and *Number of Patents* = number of patents owned by the firm.

Exploratory Capabilities and Exploitative Capabilities

The relationship between exploratory capabilities and exploitative capabilities of firms was investigated using Pearson's product-moment correlation coefficient. As mentioned earlier, the dataset meets the assumptions of normality, linearity and homoscedasticity. There is a strong positive correlation between exploratory capabilities and exploitative capabilities, r = 0.50, N = 113, $p < 0.01$, indicating that high levels of exploratory capabilities are associated with high levels of exploitative capabilities and *vice versa* (Table 5.39). These results support hypotheses (H_5): *Exploratory capabilities and exploitative capabilities of firms are positively correlated.*

Table 5.39. Correlation between Exploratory Capabilities and Exploitative Capabilities

		Exploratory Capabilities	***Exploitative Capabilities***
Exploratory Capabilities	Pearson Correlation	1	0.50**
	Sig. (2-tailed)		0.00
Exploitative Capabilities	Pearson Correlation	0.50**	1
	Sig. (2-tailed)	0.00	

NOTE: **. Correlation is significant at the 0.01 level (2-tailed); N = 113

Entrepreneurial Capabilities and Firm Performance

The effects of the two components of entrepreneurial capabilities on firm performance were tested next.

Exploratory Capabilities and Firm Performance

Table 5.40 presents the results of the regression analysis of the influence of exploratory capabilities on firm performance, after controlling for firm size, firm age, R&D intensity, marketing intensity and number of patens. Control variables were entered at step 1, R^2 was 0.06 explaining 6% of the variance in firm performance. Marketing intensity was the only control variable that was significant in Model 1 with $\beta = 0.27$, $p < 0.05$. After entry of exploratory capabilities at Step 2, the total variance explained by the model as a whole was 10%, F (6, 106) = 1.90, $p = 0.09$. The results show that the independent variable exploratory capabilities is a statistically significant predictor of firm performance, after controlling for firm size, firm age, R&D intensity, marketing intensity and number of patents, R^2 change = 0.04, F change (1,106) = 4.34, $p < 0.05$ and with $\beta = 0.21$, $p < 0.05$. Marketing intensity was the only statistically significant control variable in Model 2 with $\beta = 0.28$, $p < 0.05$. Confirming that marketing is a significant predictor of firm performance (Kotabe, Srinivasan and Aulakh, 2002; Morgan, Vorhies and Mason, 2009; Vorhies and Morgan,2005),

Table 5.40. Hierarchical Regression: The Effect of Exploratory Capabilities on Firm Performance

	Model 1		***Model 2***	
	Beta[a]	***t*-value**	**Beta[a]**	***t*-value**
(Constant)		16.00***		8.76***
Firm Size	0.00	0.03	-0.02	-0.15
Firm Age	0.07	0.57	0.05	0.40
R&D Intensity	-0.10	-0.81	-0.14	-1.19
Marketing Intensity	0.27	2.58*	0.28	2.69*
Number of Patents	-0.04	-0.37	-0.08	-0.73
Exploratory Capabilities			0.21	2.08*
R^2		0.06		0.10
Adjusted R^2		0.02		0.05
F		1.37		1.90
F Change		1.37		4.34
R^2 Change		0.06		0.04

Note: [a] Standardized Coefficients; **p < 0.05, ** p < 0.01, *** p < 0.001;* N= 113; *Firm Age* = the number of years a firm has been in operation since the date of establishment; *Firm Size* = the number of employees in the firm; *R&D Intensity* = how much money out of the sales revenue of a firm is spent on R&D; *Marketing Intensity* = how much money out of the sales revenue spent on marketing; and *Number of Patents* = number of patents owned by the firm.

this indicates that marketing intensity can have a positively significant influence on firm performance even if a firm is more focused on exploration. These results support hypothesis (H_6): *Exploratory capabilities are positively related to firm performance.*

Exploitative Capabilities and Firm Performance

Table 5.41 shows the results of the regression analysis of effect of exploitative capabilities on firm performance, after controlling for firm size, firm age, R&D intensity, marketing intensity and number of patens. Control variables were entered at Step 1 where R^2 was 0.06 explaining 6% of the variance in firm performance. Marketing intensity was the only control variable that was statistically significant in Model 1 with β= 0.27 and $p < 0.05$. After entry of the exploitative capabilities at Step 2, the total variance explained by Model 2 as a whole was 10%, $F(6, 106) = 2.06$, $p = 0.06$. The results reveal that the independent variable exploitative capabilities is a statistically significant predictor of firm performance, after controlling for firm size, firm age, R&D intensity, marketing intensity and number of patens, R^2 change = 0.04, F change (1,106) = 5.24, $p < 0.05$ and with β = 0.22 and $p < 0.05$.

Table 5.41. Hierarchical Regression: The Effect of Exploitative Capabilities on Firm Performance

	Model 1		***Model 2***	
	Beta[a]	***t*-value**	**Beta[a]**	***t*-value**
(Constant)		16.00***		5.63***
Firm Size	0.00	0.03	-0.03	-0.22
Firm Age	0.07	0.57	0.06	0.50
R&D Intensity	-0.10	-0.81	-0.10	-0.83
Marketing Intensity	0.27	2.58*	0.27	2.60*
Number of Patents	-0.04	-0.37	-0.07	-0.64
Exploitative Capabilities			0.22	2.29*
R^2		0.06		0.10
Adjusted R^2		0.02		0.05
F		1.37		2.06
F Change		1.37		5.24
R^2 Change		0.06		0.04

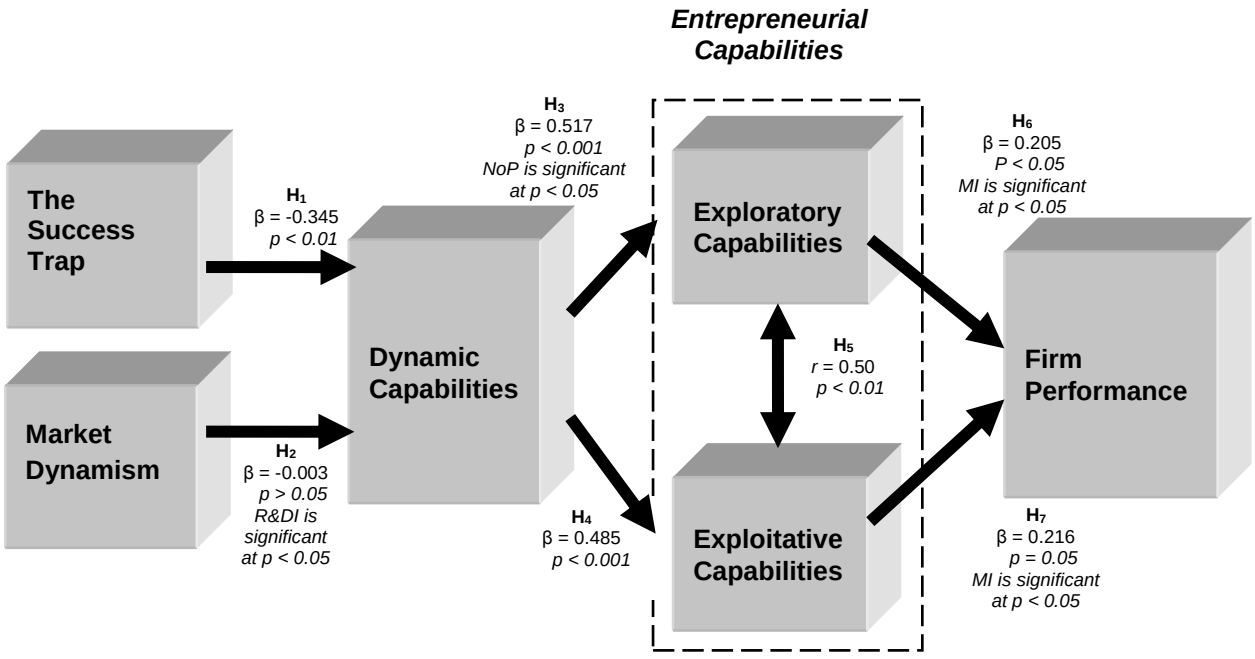
Note: [a] Standardized Coefficients; *$p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; N= 113; *Firm Size* = the number of employees in the firm; *Firm Age* = the number of years a firm has been in operation since the date of establishment; *R&D Intensity* = how much money out of the sales revenue of a firm is spent on R&D; *Marketing Intensity* = how much money out of the sales revenue spent on marketing; and *Number of Patents* = number of patents owned by the firm.

Furthermore, marketing intensity was the only statistically significant control variable in Model 2 with β = 0.27, $p < 0.05$. As mentioned above, confirming that marketing intensity is

a significant predictor of firm performance (Kotabe, Srinivasan and Aulakh, 2002; Morgan, Vorhies and Mason, 2009; Vorhies and Morgan, 2005), this proves the positive effect of marketing intensity on the performance of a firm that is more focused on exploitation. These results support hypothesis (H_7): *Exploitative capabilities are positively related to firm performance.*

5.8. Summary

This chapter presented the quantitative data analysis and findings of the study. First, the exploratory data analysis was carried out and then the key constructs were subjected to EFA. The hypotheses were tested employing correlation analysis and hierarchical regression analysis. The correlation coefficients (r and p values) and regression coefficients (standardised β and p values) are presented in Figure 5.9 and the results of hypothesis testing are summarised in Table 5.42.



Control Variables: FS=*Firm Size, FA=Firm Age, R&DI=R&D Intensity, MI=Marketing Intensity and NoP=Number of Patents*

Figure 5.9. Research Model with Results

Table 5.42. Results of Hypotheses Testing

Hypothesis		Result
H_1	*The success trap has a negative influence on dynamic capabilities of a firm.*	Supported
H_2	*Market dynamism has a positive influence on dynamic capabilities of a firm.*	Not supported
H_3	*Dynamic capabilities have a positive relationship with exploratory capabilities of firms.*	Supported
H_4	*Dynamic capabilities have a positive relationship with exploitative capabilities.*	Supported
H_5	*Exploratory capabilities and exploitative capabilities of firms are positively correlated.*	Supported
H_6	*Exploratory capabilities are positively related to firm performance.*	Supported
H_7	*Exploitative capabilities are positively related to firm performance.*	Supported

The results of the quantitative data analysis clarify some of the ambiguities in the strategic management literature. First, the quantitative findings reveal that the success trap can have a significant negative effect on the level of DCs of firms. It should also be noted that firms may stick to their existing capabilities or substantive capabilities due to different reasons that may confine them to the success trap. Next, the results explain the relationship between market dynamism and DCs that has been long debated in the literature. The quantitative findings show that market dynamism is not a significant predictor of the level of DCs of a firm. There could be other factors affecting this relationship that could not be identified in the quantitative data analysis. Furthermore, the above finding could be context specific as the study was focused only on the UK high-tech SMEs. As far as the relationship between DCs and entrepreneurial capabilities is concerned, it was found that DCs are a significant predictor of the level of both exploratory capabilities and exploitative capabilities of a firm indicating that high-tech SMEs with higher levels of DCs tend to be more entrepreneurial. Furthermore, exploratory capabilities and exploitative capabilities of firms are significantly positively correlated and are also significant predictors of firm performance. The qualitative findings presented in Chapter 6 provide more insights into the quantitative findings above. Both quantitative and qualitative findings are discussed in Chapter 7.

Chapter 6: Qualitative Data Analysis

6.1. Introduction

This chapter presents the findings of the qualitative data analysis. As mentioned in Chapter 4, based on their willingness to participate in the qualitative stage of the study, semi-structured interviews were conducted with 20 senior executives of 20 SMEs across the five high-tech industries who also participated in the survey. Profiles of the firms included in the qualitative study are presented in Table 6.1.The fact that the firms represent different industries, age groups and sizes increases the validity of the findings. In light of the qualitative data, the chapter examines how commonalities of DCs across firm are linked to specific routines in the firms studied in the qualitative stage. Moreover, the analysis of qualitative data was aimed at providing further insights into the hypotheses tested in Chapter 5. Thus, this chapter is structured into five sections: understanding DCs, the success trap and DCs, market dynamism and DCs, DCs and entrepreneurial capabilities, and entrepreneurial capabilities and firm performance. The qualitative data structure is presented in Appendix 17.

6.2. Understanding Dynamic Capabilities

The DCs could reflect a firm's ability to gain competitive advantage in a new and innovative way (Teece, Pisano and Schuen, 1997). Thus, the primary objective of this study was to understand the construct of DCs predominantly adopting the survey method. Even though, the extant literature mainly focuses on firm-specific processes and routines or the idiosyncrasies of DCs, Eisenhardt and Martin (2000) argue that commonalities of DCs also exist across firms. As discussed earlier, scholars have attempted to explicate DCs focusing on identifying the component factors of the construct. Particularly, Pandza and Holt (2007) and Wang and Ahmed (2007) contribute to the conceptual understanding of DCs where the former two authors argue that DCs consist of two components that are claimed to reflect the common features of DCs across firms, namely *absorptive capability* and *transformative capability*, whereas the latter two authors propose three component factors of DCs, namely *adaptive capability, absorptive capability* and *innovative capability* in light of empirical and conceptual evidence. In the quantitative analysis in Chapter 5, in line with Pandza and Holt's (2007), two components of DCs, i.e. absorptive capability and transformative capability that reflect commonalities of DCs across firms were identified. Thus, this section is aimed at

identifying specific routines in which absorptive capability and transformative capability are embedded.

6.2.1. Sources and Mechanisms of Absorptive Capability

Absorptive capability demonstrates firms' ability to acquire and assimilate new knowledge (Cohen and Levinthal, 1990). The following practices could be observed related to the sample firms' ability to acquire and assimilate new knowledge in the analysis of qualitative data.

Acquiring New Knowledge

First, the findings suggest that the high-tech SMEs studied seem not to follow a formal process in acquiring new knowledge. They deal with new ideas or new knowledge on ad-hoc basis as it comes. Being small in size and having limited resources, the firms tend to adopt such an informal approach in dealing with new knowledge. The following quote exemplifies this fact.

> Well, we don't have a formal ideas process like a larger company has. The ideas we have generally come out...the ideas that impact, or the ideas that develop and provide solutions to our customers what we create that every application that we consider, we do a review and we talk about how...whether we can process it, how we can process it...See the application to make sure we give the best solution to the application. Out of that process, lots of ideas come about and generally put ourselves the question to technology team on the wisdom of or the logic of what we are currently doing and challenging...all the time by questioning should we do this like this?, should we do this like this? And then, those new ideas go for process improvement. (Chief Executive Officer, Aero-1)

It seems that the approach and the level of capabilities in acquiring new knowledge depend on the expertise of the technology team of a high-tech SME. This could be a common characteristic of SMEs where Gray (2006) found significant differences between SMEs in their absorptive capability depending on, among other factors, the level of education and staff development. In addition to this, Hutchinson and Quintas (2008) claim that, as compared with large organisations, due to differing needs and high cost, formal knowledge management processes may not be appropriate for SMEs. Therefore, addressing the issue of knowledge management that is critical for absorptive capability of firms, Hutchinson and Quintas (2008) conclude that SMEs tend to engage in informal knowledge management.

Table 6.1.Profile of the Sample of the Qualitative Study

Industry	Firm	Year Established	Number of Employees	Core Products	Location	Interviewee	Mode of the Interview	Date of the Interview
Aerospace	Aero-1	2005	5*	Coatings	Northamptonshire	Chief Executive Officer	Telephone	03/08/2011
	Aero-2	1980	25	Alloy ingots	West Midlands	Sales Engineer	Telephone	02/08/ 2011
	Aero-3	1969	100	Solutions for interconnects and electrical assemblies	Staffordshire	Business Development Manager	Telephone	11/08/2011
	Aero-4	1960	245	Aircraft interiors	Surrey	Marketing Manager	Telephone	17/08/2011
Pharmaceuticals and Biotechnology	P&B-1	1947	10	Medicines and raw materials	Middlesex	Managing Director	Telephone	22/06/2011
	P&B-2	2006	80	Antibodies	Oxfordshire	Managing Director	Face-to face	29/06/2011
	P&B-3	2008	100	Life science solutions	Oxfordshire	Bioanalytics Project Manager	Telephone	12/08/ 2011
	P&B-4	2001	14	Sample preparation products, consumables and reagents	Berkshire	Chief Executive Officer	Telephone	08/09/ 2011
	P&B-5	2005	2*	Biomarkers for neuropsychiatric illnesses.	Cambridge	Executive Chairman	Telephone	08/09/2011
Office and Computing	O&C-1	1991	40	Office communications solutions and IT services	London	IT Consultant	Face-to face	09/06/2011
	O&C-2	2008	35	Intelligent wireless solutions	Hertfordshire	Executive Chairman	Telephone	01/08/2011
	O&C-3	2007	8*	Web solutions	Cambridgeshire	Managing Director	Telephone	12/08/ 2011
	O&C-4	2003	130	Location solutions	Cambridgeshire	Lead Architect-Hardware Systems	Telephone	16/08/ 2011
	O&C-5	2006	7*	Encoding technology	Cambridgeshire	Research Director	Telephone	26/08/ 2011
Radio, TV and Communication	RT&C-1	1991	120	Printed circuit boards	Devon	Sales Director	Telephone	28/06/2011
	RT&C-2	1985	33	Radio Frequency equipment	Waltham Abbey	Finance Director	Telephone	06/09/ 2011
	RT&C-3	2000	87	CCTV systems	Essex	Commercial Manager	Telephone	08/09/ 2011
Medical and Optical Equipment	M&O-1	1964	130	Single use medical devices	Hertfordshire	Managing Director	Telephone	27/07/ 2011
	M&O-2	1988	35	Otoacoustic emissions instruments	Hertfordshire	Chief Administrator	Telephone	07/09/2011
	M&O-3	1956	92	Life support products	Greater London	Marketing Manager	Telephone	27/09/ 2011

NOTE:*These firms belonged to the category of small firms that reported 10-49 employees at the time of selecting the sample of the study. The number of employees had dropped over the three year period considered for the study. Since number of employees was an indicator of non-financial performance of the firms and the decrease in the number of employees indicated a decline in firm performance, those firms were still retained in the final sample used for the data analysis.

Second, the high-tech SMEs show that they engage in searching for scientific literature and creating collaborations with academics in finding new knowledge. There is a large number of high-tech SMEs which are spin-off firms of established universities and they tend to search for the latest scientific literature for innovative product ideas and also look for collaborations, for example, with university academics. This seems to be a good source of new knowledge for those firms. As an interviewee put it:

> …one of the things, people always try to keep up to date with is the scientific literature. That is why…going to conferences, trying to know what people are talking about. Reading publications…hopefully talking to scientists in their departments etc...We actually would try to find out what people are interested in. And then, all that kind of [information] get fed back in to the team so then discuss which areas they kind of going to be developing in the next year or two. And then, we work out what the priorities are going to be from there. And really decide which products we want to develop or move forward with. (Managing Director, P&B-2)

The bioanalytics project manager of firm P&B-3 shared a similar view:

> ...What we do is, there is a lot of literature search that is quite often. An academic group or someone who has published in the literature that tells us why we might bring the new type of test to the customer. We can use that or a new technique, we can research into that. With that scientific background, we can try to keep that knowledge. (Bioanalytics Project Manager, P&B-3)

Interestingly, both above SMEs are from the pharmaceutical industry where most of the senior managers are from a strong academic background, for example, the managing director of firm P&B-2.

> I am a PhD scientist, immunologist by training. After my PhD, I spent about 4 or 5 years in the [a public sector organization in the UK] in a diagnostic lab.Then came straight to [P&B-2]. I have been working for [P&B-2] for something like 17 years. (Managing Director, P&B-2)

This tendency indicates that the high-tech SMEs seek opportunities to acquire new knowledge through academic sources. High-tech SMEs need contacts with universities throughout their life-cycle as they need these relationships for reasons such as product and process innovation (Hendry, Brown and Defillippi, 2000). Particularly, for science-based high-tech firms (e.g. biotechnology firms), academia can be an important external source of technology (Autio, 1997).

Third, it also came to light that collaborations with suppliers/industry partners are another important source of new knowledge for high-tech SMEs. As senior executives from P&B-5 and RT&C-2 explained:

> Well, we acquired new knowledge by collaborating with other parties...That was shared by a number of different people participating in projects. (Executive Chairman, P&B-5)

> ...That is the kind of start you need. You call various suppliers to supply with technical knowledge. (Finance Director, RT&C-2)

By adopting this strategy in acquiring knowledge, firms will be able to establish strong ties with their suppliers and industry partners (Kay, 1993). In addition to collaborating with the academics and suppliers or industry partners, high-tech SMEs, also use their customer base as a useful source of new knowledge. For example, the innovators of novel, commercially successful scientific instruments are, most often, the users (Von Hippel, 1988). Therefore, fourth, as the interviewees described, networking with customers could increase the absorptive capacity of high-tech SMEs.

> Most of our knowledge is acquired by going in to the market, by meeting customers, and collaborators. And that is where most of the knowledge is supplied to us. (Chief Executive Officer, P&B-4)

> ...And, you know, the best way to get information is to talk to customers, find out what they use. Customers use both systems that haven't worked...We are keen to tell you why it didn't work, why it didn't solve their problem. And we get intelligence on how to avoid happening it in the future. (Lead Architect-Hardware Systems, O&C-4)

Assimilating New Knowledge

The high-tech SMEs adopt rather common practices in assimilating and applying new knowledge. First, it was noticed that the new knowledge acquired is assimilated to the firm using formal or informal mechanisms. This could be observed across firms from different high-tech industries. For example, senior executives from firms P&B-2 and Aero-3 claimed that they adopt formal processes of assimilating new knowledge:

> Yeah. I mean, for instance, we have one of the major forums. It is a big quarterly meeting that involves all those sales and marketing teams and the product development teams where they come…bring ideas together, talk about them, decide which ones are good ones which ones are not so good. (Managing Director, P&B-2)

> Those who are involved in a project that needs it, research it...with suppliers, with customers, with publicly available information and seminars, things like that. And then, when we win the business we train our colleagues on it. (Business Development Manager, Aero-3)

On the other hand, firm P&B-2 adopts a rather informal approach:

> ...We have some meetings. But most of the time it is informal. Because, you know, we are sitting next to each other on the desk and... You know we discuss openly between us. (Chief Executive Officer, P&B-4)

The above data confirm the findings of Hutchinson and Quintas (2008) who concluded that some SMEs can be engaged in informal knowledge management and while some others can do formal knowledge management.

Second, the development of an organisation's absorptive capability can be based on prior investment in the development of its members' individual capability (Cohen and Levinthal, 1990). Thus, in the context of high-tech SMEs, the firms are keen on developing internal expertise that increases their absorptive capability at firm level. The firms invest in developing skills of existing people and hiring people with skills:

> We train our staff. We invest a lot on training our people on new technologies. We send them for all the best training programmes, workshops. (IT Consultant, O&C-1)

> Basically it is through research. We do our own internal or in-house research. But there are also other researchers around the world who are creating and developing their own theses. (Chief Administrator, M&O-2)

> We really recruit people with a very broad background. Which means that they are very much capable of learning within the position, adapting, solving problems, in different ways. And, we grow that knowledge base through a combination of internal training, general personal development, and using consultants as and when necessary, because we don't have in-house. (Lead Architect-Hardware Systems, O&C-4)

The above findings suggest that high-tech SMEs use collaborations with different parties to acquire new knowledge and use formal as well as informal mechanisms in assimilating new knowledge into the firm. For example, Kodama's (2008) study shows that university-industry linkages and inter-firm linkages lead to different outcomes of SMEs. Kodama (2008) also found that linkage with universities, large firms and other

SMEs can have different impacts on product developing SMEs: a university linkage has an effect on the likelihood of patent applications, a large firm linkage is effective in increasing the likelihood of a new product being introduced, and an inter-SME linkage affect the likelihood and number of new products. In addition, the firms have been developing their existing staff and hiring new people in increasing the absorptive capability at firm level. This is required for SMEs as identification of external information, absorption of such information and the improvement of SME performance can be facilitated by internal expertise (Bougrain and Haudeville, 2002).

The broader indicative themes developed based on Garcia-Morales et al.(2008), i.e. (a) the firms have a clear division of roles and responsibilities for acquiring new knowledge and (b) the firms have the competences to transform the newly acquired knowledge, helped in identifying the above practices related to absorptive capability of high-tech SMEs: (1) high-tech SMEs may not adopt a formal process in acquiring new knowledge, (2) search for scientific literature and collaborations with academics may help high-tech SMEs find new knowledge, (3) collaborations with suppliers/industry partners can be a main source of new knowledge for high-tech SMEs, (4) customers can be a main source of knowledge for high-tech SMEs, (5) high-tech SMEs may use formal mechanisms or informal mechanisms to assimilate new knowledge, (6) high-tech SMEs may use internal expertise (developing skills of existing people and hiring people with skills). Overall, the above analysis indicates that UK high-tech SMEs have a fairly high level of absorptive capability. However, the effect of knowledge absorbed, and assimilated, using absorptive capability, on firm performance could depend on transformative capability of firms.

6.2.2. Sources and Mechanisms of Transformative Capability

In understanding the transformative capability of firms, both adaptive and innovative aspects were taken into consideration. The main focus was to identify the extent the high-tech SMEs are capable of transforming the acquired and assimilated knowledge in the form of reconfiguring activities in the business unit quickly to meet changing demands in the task environment (Gibson and Brikinshaw, 2004) and introducing new products and production-service technologies, searching for novel solutions to marketing and production problems, and attempting to lead competitors, and risk-taking (Miller and Friesen, 1983). Transformative capability demonstrates the capability to constantly create or redefine product or service opportunities based on knowledge

within the firm (Pandza and Holt, 2007). The analysis revealed a set of important practices related to transformative capability of high-tech SMEs.

First, as it was mentioned earlier, it is important for high -tech SMEs to recruit capable people, and maintain and develop existing people to increase their absorptive capability. As suggested by Pitt (2005:322) such efforts will contribute significantly to strategic change only if "the senior figures tolerate, indeed encourage debate and constructive disagreement" within the firm. Thus, the interview findings clearly demonstrate this practice where firms adopt an interactive and informal approach in encouraging people to challenge the status quo as the managers themselves are a part of not only in making decisions but also in implementing those decisions in SMEs. As the marketing manager of firm Aero-4 claimed:

> I think the business listens and reacts...brought in information and looks for change in behaviour. I mean that is a part of the management involved in as well. Whether it is a part of internally by an employee or a customer, the management is on watch, they monitor. That is an abstraction of what we look and review and we make a decision how we are going to react to it...do investigate to get people to involve in and we will discuss it. (Marketing Manager, Aero-4)

Second, the high-tech SMEs are highly flexible in responding to change. This flexibility is their comparative advantage (Baldwin, 2000:10) and as evident in the interviews, this is an inherent characteristic of those firms being small. As the senior executives from firm Aero-1 and firm P&B-4 put it:

> ...We can see very quickly how the environment changes and how they are impacting on what we do. We meet regularly and we review our processes and we review the key networks within our business and we decide what changes we need to make. (Chief Executive Officer, Aero-1)

> So, you know,...to switch from one project to another project very very rapidly, and you can do that, you know, in a flip second of a discussion. So, you are able to respond quickly and respond to changes. You know, you got to remember things are that much on the back of an envelope in a small company...Much more responsive. There are very few authorisation levels in a small company. (Chief Executive Officer, P&B-4)

Even though, the SMEs have the advantage of being small, they could have other limitations. Particularly, high-tech SMEs need to respond rapidly where they need to develop mechanisms and deploy resources to take advantage of the opportunities

quickly; however lack of financial resources and knowledge resources can be a key constraint faced by SMEs (Freeman, Edwards and Schroder, 2006). This was revealed by the chief executive officer of firm P&B-4.

Interestingly, firms cope with resource constraints by using external resources (e.g. Aero-2). Thus, the firms who are strategic would overcome above the barriers. Zahra, Filatotchev and Wright (2009) argue that threshold firms can creatively offset their limitations in resources.

Third, how the firms evolve in response to business priorities indicates the level of transformative capability. The high-tech SMEs have been very adaptive to the changes in the environment and they changed their business priorities to suite those changes. For example, the firms have refocused their resources to different markets (e.g. Aero-1) and have focused on improving processes to cope with the changes (e.g. P&B-3), and some other firms have changed even their managers (e.g. M&O-3):

> …some key sectors that we completely dropped because we recognised we are not the best for those sectors. We think we have focused our resources more on particular market sectors. (Chief Executive Officer, Aero-1)

> The competition is very high. At the moment we are taking on a specific process…The company has got quite a few process improvement managers. We have got one on-site now. ...The staff have changed their roles they are trying to support and streamline things. (Bioanalytics Project Manager, P&B-3)

> I mean everything is changing really as much as. Over the last four years, a series of new managers have been brought in to help existing managers or to replace in some cases.(Marketing Manager, M&O-3)

Thus, above practices and characteristics show that, overall, the high-tech SMEs are adaptive. The adaptive capability of high-tech SMEs depends on the extent of availability of human and material resources (Chakravarthy, 1982) and their capacity to learn at a rate faster than the rate of change in the conditions (Staber and Sydow, 2002). However, firms need to adapt and innovate simultaneously to survive in the long-run (Brown and Eisenhardt, 1997; Tushman and O'Reilly, 1996) and therefore, they require not only adaptive capability but also innovative capability which are the two components of their transformative capability. Thus, it was further examined to identify how innovative the firms have been.

Fourth, as exemplified in the following quotes, the sample firms have introduced improvements and innovation to a greater extent.

> I think, we have been quite innovative in developing our own products and our own processes...optimising our process. And so we have a stream of ideas we think we could eventually commercialise through patent. So, that is one measure of innovation. Another way, I can say that we have been innovative in that we develop solutions to customers who have been elsewhere and haven't found solutions. And we have been able to provide them the target lifetime or performance. (Chief Executive Officer, Aero-1)

> ...innovation is at the heart of the company. You know, we have to have solutions you can't buy from anybody else. Otherwise, the customers are not going to buy from us. So, he [or she] always has the alternative of developing technology himself [or herself]. And our job is to it before he [or she] knows he [or she] can. (Executive Chairman, O&C-2)

While claiming that successful product innovation is vital for SMEs, Avlonitis and Salavou (2007) concluded that SMEs who are active entrepreneurs differ significantly from passive entrepreneurs in terms of new product uniqueness. The sample firms have been innovative in developing new processes and products. In addition, these high-tech SMEs are driven by innovations and they harness their existing technology to come up with innovative products. As reported by Avlonitis and Salavou (2007), the UK high-tech SMEs demonstrate their ability to deliver unique solutions.

Fifth, the firms have been creative in methods of operation. This is important for high-tech SMEs because, for example, designing new processes and methods of production can improve of firm performance (Antoncic et al., 2007). The managing director, M&O-1 described how the firm was restructured to increase the efficiency of operations.

> One of the key things is where we restructured in terms of the new product development team, marketing and sales...Headed up by one person, so they are linked up together. So, they are not separate. And then we removed the barrier between the two. (Managing Director, M&O-1)

Sixth, clearly, these firms are motivated to seek out new solutions. They keep investing their resources in developing and applying new solutions. This would help them stand out in the competition.

> And now we are trying to stay ahead in the pharmaceutical drug testing field. So, it is focused on innovation in this business unit…I would say just

> today, we were looking at a new type of instrument and finding out when we can buy it. So, we can offer very new tests to the market that currently only done by research department of some other companies. (Bioanalytics Project Manager, P&B-3)

Apart from the above practices and characteristics related to transformative capability of high-tech SMEs, it could be noticed that limited resources affect their capability in innovating. For example, Qian and Li (2003) found that biotechnology SMEs had to concentrate their limited resources on certain market niches in their pursuit of innovator strategy due to their size and consequent resource shortages. However, interviewees shared both positive (M&O-2) and negative (P&B-4) views.

> So, basically, we have our own in-house R&D department. They are always looking to improve our offerings to offer new facilities and to offer new technologies that will assist us stay ahead of the competition. So, we provide instrumentation that can compete very fiercely with others in the marketplace. (Chief Administrator, M&O-2)

> It has been relatively innovative. But the problem we have is, like you have in a small company, not having enough people to fulfil these aspects of the work. So, we spend lot of time doing housekeeping duties, supporting standard function, bread and butter function within the company. (Cheif Executive Officer, P&B-4)

However, as it was mentioned earlier, firms go for collaborations and partnerships and adopt other innovative strategies to overcome resource constraints.

Thus, the findings of the qualitative data analysis reveal that high-tech SMEs demonstrate the practices and characteristics identified in the literature which can be summarised as follow: (1) people those firms are encouraged to challenge the status quo, (2) the firms are flexible in responding to change, (3) the firms evolve in response to business priorities (1-3 demonstrate the adaptive aspect of transformative capability, and are based on Gibson and Birkinshaw, 2004), (4) The firms introduce improvements and innovations in the business, (5) The firms are creative in their methods of operation, (6) The firms are good in seeking out new solutions (4 and 5 demonstrate the innovative aspect of transformative capability, and are based on Hughes and Morgan, 2007), and as emerged in the analysis, (7) the limited resources affect innovation. In addition, the firms have been innovative in managing resource constraints as well. Therefore, the

above findings suggest that high-tech SMEs possess a fairly high level of transformative capability.

As far as the levels of absorptive capability and transformative capability are concerned, the firms report a high level of DCs which is in agreement with the findings of the quantitative analysis in Chapter 4. The next section examines the role of market dynamism and success traps in developing DCs.

6.2.3. Absorptive Capability and Transformative Capability as the Components of Dynamic Capabilities in UK High-Tech SMEs

The analysis of interview data indicates that DCs of high-tech SMEs can be clearly assessed under the two components of absorptive capability and transformative capability which is in agreement with the findings of the quantitative data analysis in Chapter 5. The absorptive capability could be identified as the capabilities in acquiring external knowledge and disseminating knowledge in the firm (Liao, Welsch and Stoica, 2003) whereas transformative capability (Garud and Nayyar, 1994; Pandza and Holt, 2007) included adaptive capability and innovative capability. Zhara and George (2002) redefine the original construct absorptive capability (absorptive capacity) introduced by Cohen and Levinthal (1990) classifying the construct into realised absorptive capability and potential absorptive capability incorporating almost all the elements of DCs into absorptive capability. At the same time, they describe absorptive capability (capacity) as a DC. Wang and Ahmed's (2007) classification of DCs also clearly identify absorptive capability a component of DCs.

As far as the high-tech SMEs are concerned, it is important to clearly distinguish between absorptive capability and transformative capability. For example, Pandza and Holt (2007:350) claim that "...smaller technology-driven firms, who have established an identity based on their expertise in aspects of an emergent technology, have a need less for absorptive capacity [absorptive capability] than transformative capacity [transformative capability]". They further describe absorptive capability as 'demand-driven' and transformative capability as 'supply-driven'. Therefore, based on these interpretations in the literature, it could be observed that the UK high-tech SMEs demonstrate a high level of capabilities in acquiring exogenous knowledge and assimilate that knowledge into the firm. They also demonstrate a high level of transformative capability that is represented by their ability to adapt and innovate

products and processes using their endogenous knowledge. As it was mentioned in the literature review, adaptive capability involves "the state of adaptation that a firm aspires" (Chakravarthy, 1982:37) and innovative capability "concerns the specific expertise and competence related to the development and introduction of new processes and products" (Hagedoorn and Duysters, 2002:168). It was evident in the analysis that the firms are good at both absorbing and transforming new knowledge.

6.3. The Success Trap and Dynamic Capabilities of High-Tech SMEs

Based on the qualitative findings, this section further explores the hypothesised negative effect of the success trap on DCs (H_1) that was statistically supported in Chapter 5.

First, the interviews highlighted that the high-tech SMEs are not confined to established technologies in the market. The firms are committed to world class innovation, which is at the heart of those firms. For example, as the executive chairman of firm O&C-2 put it:

> So, at the core of the company is, we design a new DSP (digital signal processor). That is innovative, a world class innovation. What is around that design is a new processor. We are building other new stuff to do software and programming mix. (Executive Chairman, O&C-2)

Second, the firms invest large amount of resources on research and development that result in radically new technologies or what they call next generation systems. They have been more realistic by keeping an eye on existing technologies as well. This was revealed in the interviews. The Managing Director of firm O&C-4 described that:

> We make very large investments in research and development to maintain our competitive edge and to develop technologies... Also, we form the basis of the next generation system... You know keeping one eye forward on these developments and also one eye on what everyone else is doing. (Managing Director, O&C-4)

Third, in utilising their limited resources in a highly effective and efficient manner, high-tech SMEs have been very systematic in undertaking a project on radically new technologies to make sure that they are going to succeed. As the managing director of firm P&B-2 explained:

> So, we have to, as I said, use the scientific literature etc to work out if there is a market. And we try to correlate…If we are thinking of introducing a new product, we will assess it with various scores of what we think the market would be. (Managing Director, P&B-2)

Fourth, it was further revealed in the interviews that the high-tech SMEs continuously look for ways of breaking out the status quo. For example, the commercial manager of firm RT&C-3 stated that:

> Yes. They [the firm] are always investing in research. They [the firm] do a lot of research in new products for [an institutional customer] actually...They are always looking for the smaller transmitters to go on vehicles etc. (Commercial Manager, RT&C-3)

The interview findings as illustrated above demonstrate that high-tech SMEs are committed to work on radically new technologies. Thus, while indicating a moderate level of risk of the UK high-tech SMEs falling in to the success trap, the interview responses show that the firms maintain a high level of the DCs as well, i.e. absorptive capability and transformative capability. The hypothesised negative relationship between the success trap and DCs that was supported in the statistical test in Chapter 5 is complemented by the qualitative data. The following responses particularly support the above hypothesis.

The firms drive change and they set the boundaries of technologies. As the marketing manager of firm Aero-4 put it "We look out for change". In addition, expertise is developed within the firms in developing their own technologies. Senior executives from firm M&O-1 and firm P&B-2 noted:

> I would say, internally what we did was we developed the management. We hired people and trained them...as an organisation, we develop our own technology. (Managing Director, M&O-1)

> Out of the 80 people here, we have twenty people in production or in the laboratory and about… we have 12 in marketing, five in product development. Most of those are scientists, say about half of the company are just scientists. (Managing Director, P&B-2)

Furthermore, as mentioned above, in firm P&B-2, people always try to keep up to date with the scientific literature and find out what people are interested in and then decide which products the firm wants to develop.

Firms have made it fundamental for people to create as it is a part of firm's existence. Thus people are encouraged to challenge the status quo (e.g. firm O&C-2). Furthermore, firms thrive in the industry by being more dynamic and staying ahead of competition. Following are examples from the pharmaceutical and biotechnology industry:

> And now we are trying to stay ahead in the pharmaceutical drug testing field. So, it is focused on innovation in this business unit. (Bioanalytics Project Manager, P&B-3)

> Well, the reasons for developing a relationship with us, as I mentioned, to get access to the technology for measuring protein in blood. Because, that was a technology that was problematic, but we had done it very effectively. (Executive Chairman, P&B-5)

Thus, by driving change and setting the boundaries of technologies, developing expertise within the firms in developing firms' own technologies, making it fundamental for people to create as it is a part of firm's existence, and thriving in the industry by being more dynamic and staying ahead of competition, the UK high-tech SMEs have been able to control the risk of being confined to the success trap and in turn to develop DCs within those firms. Therefore, overall, the above findings reveal that the moderate level of success trap has resulted in a high level of DCs supporting the negative relationship between the two constructs that was supported in the statistical testing. Particularly, majority of the firms interviewed are naturally innovative and they are in the business due to their high level of DCs. Since the UK high-tech SMEs are not caught in the success trap to a significant extent, learning takes place in those firms and as Miller (2003: 971) put it, "as learning takes place, a firm is able to apply the capabilities learned and resources earned in one situation to serve a different market or opportunity". This involves leveraging existing capabilities while using them as a stepping stone to build a new capability (Danneels, 2002).

6.4. Market Dynamism and Dynamic Capabilities of High-Tech SMEs

The hypothesised positive relationship between market dynamism and DCs ($H_{2)}$ was not statistically supported in Chapter 5. As it was mentioned in Chapter 3, there were

arguments for and against this relationship in the literature. Therefore, this section provides further insights into the findings of quantitative data analysis relating the above relationship. In doing so, first, nature of market dynamism faced by high-tech SMEs is assessed by looking at customers, technology, and competition dimensions (Atuahene-Gima, 2005; Jaworski and Kohil, 1993).

First, as far as the change in customer behavior is concerned, it came to light that firms tend to stick to the same customer population over time offering same product on same scale. As proposed by Winter (2003:992), when firms adopt such an approach, "the capabilities exercised in that stationary process are the zero-level capabilities, the 'how we earn a living now' capabilities" and not DCs. The chief executive officer of firm Aero-1 proved this point: "Well, they [the customers] are not pushing us. What happens is we have a basic technology". The firm adapt this basic technology to suit the customer requirements. This resembles the above hypothetical scenario described by Winter (2003) and such an interaction with customers would not influence 'DCs' of a firm. However, such a relationship may develop customer loyalty that would discourage them from switching to competitors and creating stability in the market and help firms to address their changing needs and may also to acquire new knowledge via customers.

> No. We have a very very strong customer loyalty...who do stick with us. Primarily because, our instruments have been designed and built to be cost effective over a long run period. We can still see some of the instruments being used today that were sold...I don't know...15-20 years ago. Whereas most of the competition tends to put probably a maximum of 5 may be if you are lucky may be 7 years life on their products. (Chief Administrator, M&O-2)

Interestingly, referring to change in customer needs, the interviewees maintained that the real or standard customer needs do not change rapidly. This shows a moderately or less dynamic market situation. For example, the business development manager of firm Aero-3 highlighted this point:

> ...first thing that they [customers] need is the most up to date technology and they want the best technology. When it comes down to placing an order, they will place an order for the old technologies. (Business Development Manager, Aero-3)

Furthermore, high-tech SMEs tend to increasingly focus on niche markets (Saarenketo et al., 2004) and niche operation improves profitability of high-tech SMEs (Qian and Li, 2003). The reason behind this strategy could be to prevent customer from switching brands and also controlling change in customer preferences. For example, senior executives from firms Aero-1 and O&C-4 claimed that they focus on niche markets:

> I mean in the coating market, it is highly competitive. But, we are trying to build a niche where others are unable to compete. We think we are able to do that. (Chief Executive Officer, Aero-1)

> Most of the customers that we have are...If you want it, it is kind of the original reference customers' niche market. (Lead Architect-Hardware Systems, O&C-4)

For high-tech SMEs, particularly spin-offs, in their early stages they tend to depend on a few main customers accounted for virtually all their turnover (Pérez and Sánchez, 2003).This characteristic was partly evident in the interviews where, irrespective of the stage in their life-cycle, firms prefer to stick to a customer niche to maintain stability in the market. As it can be seen in Table 6.1, the 20 firms studied in the qualitative stage belong to different age groups. On the other hand, Romijn and Albu (2002) found that, among UK high-tech SMEs, there was no significant association of intensive customer networking with innovation; however, they did not consider customer as an unimportant source of innovation performance.

Thus, as far as the uncertainly of change in customer behaviour is concerned, it could be noticed that (1) the standard customer needs do not change rapidly and (2) creating a niche market help maintain customer stability.

Second, the technological aspect of the market is analysed. The way SMEs implement technological scanning which can depend on the firm's industrial sector can determine the way firms perceive technological change and how they deal with it (Julien et al., 1999). Thus, the rate of change in technology can be industry-specific. As it was revealed in the interviews and illustrated below, the level of rapidness in technological changes varies across different types of high-tech industries:

> I would say [technology is] relatively stable. Doesn't change that often. (Chief Executive Officer, Aero-1)

> The technology is relatively stable as well. We have had little small changes but not significant. (Marketing Manager, Aero-4)

> ...[Technology changes] quite rapidly, So, standards for mobile phone industry change every 18 months, one and a half years. And major sort of standards 2G, 3G, 4G, they change every 10 years. (Executive Chairman, O&C-2)

> It [the technology] can change quite dramatically, but it is generally, things get smaller and smaller. Whether it be the PCB [printed circuit board] to a manufacturer or the size of the traces, size of the hole we are drilling. It does evolve. (Sales Director, RT&C-1)

Change in technology can create opportunities or pose threats for individual firms; for example, quick obsolescence of components in the computer industry requires firms to periodically invest in new systems (Li and Lin, 2006). The interviews reveal that technological changes may occur due to other factors such as technological changes in complementary products as most of the high-tech SMEs do not offer a final product to the market.

> Because it is dependent on mobile phones as the platform trying to run our applications and that is very fast moving and indeed, in 2008, we were concentrating very much on [mobile phone brand X]. Because, [mobile phone brand X] smart phones were the only one in the market that could at the time run our applications. So, it was a lot of investments in 2008 into supporting [mobile phone brand X]. Now actually what has happened is once (mobile phone brand X) started to get into trouble...for us it was a major problem. Because [mobile phone brand X] broke some of the features in their phones that we needed. So, some of the newer applications could not be run on newer [mobile phone brand X] phones. (Research Director, O&C-5)

Furthermore, need for new technologies could arise due to changes in regulations, particularly in pharmaceutical and biotechnology industry. For example, the seriousness of the effect of regulatory changes on the way things are done in pharmaceutical/biotechnology firms is evident from the initiatives taken by the regulatory authorities such as the European Medicines Agency (EMEA) to facilitate the development and availability of high-quality, effective and safe medicines through providing scientific advice in meeting the regulatory requirements (Regnstrom et al., 2010).

> It [technological change] has been pretty rapid. It is driven by the regulations. So, as the drugs get more and more complex in their action... That means there are standard number of tests need to be done. Which means a set of techniques to measure different things. (P&B-3 Bioanalytics Project Manager)

On the technological aspect of market dynamism, findings can be summarised under two points: (1) the level of rapidness in technological changes varies across different types of high-tech industries and (2) the technological changes may arise due to other factors such as change in complementary technologies or regulatory changes.

Third, the competition in the market is assessed. The competitive conditions can be industry specific and competitive condition in every high tech industry may not change at the same rate. This could be a reason for firms competing in the same industry to adopt homogeneous competitive strategies for investing in technology and marketing resources (Mauri and Michaels, 1998). As the marketing manager of firm Aero-4 described:

> It is probably quite stable compared to a different environment. We know the competitors. They know us very well. We know about their products…The customers tend to have their preferred supplier. (Marketing Manager, Aero-4)

It was also revealed that the change in competitive conditions can be driven by changes in technology. For example, e-market place increases the competition and that can be a major threat to SMEs who are not e-enabled (Stockdale and Standing, 2004). Therefore, technological turbulence can lead to higher competition in the high-tech sector. An IT consultant of firm O&C-1 stated that:

> Very competitive…We have a very high competition from local as well as foreign competitors. The moves are rapid and unpredictable as technology in this industry changes every second. (IT Consultant, O&C-1)

Availability of lesser the number of competitors makes the predictability of their actions high. The executive chairman of firm O&C-2 revealed that:

> Very small number of competitors. Because, there are only, probably, three competitors in the world...and I would say they are pretty predictable. (Executive Chairman, O&C-2)

As it was mentioned earlier, the market environment of UK high-tech SMEs was assessed along there dimensions: uncertainly of change in customer behaviour, rapidness of change in technology and competition, and unpredictability in change in technology and competition.

It could be observed that firms let customers play an important role in developing their products, however, customer needs are rather stable and do not change rapidly and if they change, it depends on the types of customer, and firms' tend to create niche markets. The above characteristics demonstrate relatively stable customer behaviour in UK high-tech SME markets. For example, as the chief executive officer of firm Aero-1 claimed above, they maintain a very good relationship with their customers who play a key role in making technical decisions and as a result, there are no unexpected changes in behaviors of the customers. He went on to say: "Well, they [the customers] are not pushing us" (Chief Executive Officer, Aero-1).

With regard to the rapidness and unpredictability of change in technology, the interview data show that the level of rapidness in technological changes varies across different types of high-tech industries and the unpredictability can be caused by other factors. Depending on the type of industry a firm may use more or less a core technology where minor changes would not have significant effect on their business. For example, the business development manager of firm Aero-3 claimed that: "...we are continuously training and pushing technological boundaries ourselves. So, we are ahead of the market". It was further evident that firms are immune to the technological changes in the market in developing their DCs. This was highlighted in the interview with the chief administrator of firm M&O-2.

> ...we have our own in-house R&D department.They are always looking to improve our offerings to offer new facilities to offer new technologies that will assist us stay ahead of the competition. (Chief Administrator, M&O-2)

Furthermore, if the firms initiate the technological change, that will not create instability for them as they are prepared for the change. In addition, the extent of the use of a particular technology can vary across firms. As mentioned above, the unpredictability of technological change can depend on the rate of change in complimentary technologies and regulatory changes.

When it comes to rapidness and unpredictability of change in competition, competitive conditions can be industry specific and change in competitive conditions can be driven by technology. Furthermore, when there are a lesser number of competitors, their actions can be more predictable. As suggested by the findings of the qualitative data analysis, it can be seen that the UK high-tech SMEs face a moderate level of market dynamism. This can mainly be attributed to the unique and innovative nature of each firm operating in those industries. By nature of the product/service, they are not influenced by the general market competition. For example, referring to their business, the chief administrator of firm M&O-2 stated that:

> Whereas our instrumentation will work to normalise the signals we are delivering within the constraints of the individual we are testing. So, we are always doing a bespoke test as against to deliver the standard tests. (Chief Administrator, M&O-2)

These findings substantiate the findings of the quantitative data analysis where a market dynamism mean score of 4.03 was reported in the exploratory data analysis.

The findings of the qualitative data analysis provide insights on the hypothesised relationship between market dynamism and DCs that was not supported in statistical testing in Chapter 5. The market environment of high-tech SMEs are quite stable due to their focus on niche operations (Quian and Li, 2003) that give the firms a clear idea about the standard needs of customers and the type of needs they have. This creates a rather certain and predictable customer behaviour. In addition, loyal customers generated mainly through niche operations, guarantee a long-term customer relationship. On the technological aspect, majority of the high-tech SMEs are naturally high-tech and they have come into existence as a result of their unique technology. They drive the core technology adopted in the firm rather than being driven by external technologies. There were cases of unpredictability of changes in technology caused by changes in other factors such as regulatory changes or changes in complementary technologies. Overall, the high-tech SMEs lead their unique technology and are immune to external influences. In terms of competition in the market, as mentioned above, niche market operations and adoption of unique technologies have minimised the threat of competition for UK high-tech SMEs.

On the other hand, as it was revealed in the quantitative data analysis in Chapter 5 and the qualitative analysis above, UK high-tech SMEs demonstrate a high level of DCs: both absorptive and transformative capabilities. As a result of strong networks with customers, suppliers, industry partners, and other parties such as research laboratories and universities, firms maintain a stable knowledge in-flow; there are formal as well as informal mechanisms to assimilate such knowledge into the knowledge existing in firms. Thus, development of absorptive capability of UK hi-tech SMEs is not a reaction to changes in the market environment and it is built into the firms by nature of their operations. When it comes to transformative capability, adapting and, more importantly, innovating are inherent to those firms. They continuously adapt and innovate their products, processes and technologies in catering to their established markets. Consequently, high absorptive capability and transformative capability are not driven by the moderately dynamic market but by the nature of the business of those high-technology firms. The findings substantiate the findings of the quantitative data analysis and also challenge the claims that market dynamism has a direct effect on DCs (e.g. Eisenhardt and Martin, 2000; Pisano, 1994).

6.5. Dynamic Capabilities and Entrepreneurial Capabilities

Teece (2007:1) claims that "enterprises with strong dynamic capabilities are intensely entrepreneurial" and "they not only adapt to business ecosystems, but also shape them through innovation and through collaboration with other enterprises, entities, and institutions". As it was discussed in the previous chapters, the two key elements of entrepreneurial capabilities are exploratory capabilities and exploitative capabilities (Alvarez and Busenitz, 2001; Shane and Venkataraman, 2000). How DCs facilitate exploration and exploitation has been a major concern in this study (O'Reilly and Tushman, 2008). Thus, based on the qualitative findings, the following sections further examines the results of hypotheses tested in Chapter 5, i.e. H_3 and H_4.

6.5.1. The Effect of Dynamic Capabilities on Exploratory Capabilities of High-Tech SMEs

Based on Atuahene-Gima (2005) along with what emerged in the data analysis, the qualitative findings related to exploratory capabilities are presented mainly focusing on how firms acquire entirely new knowledge, skills and processes. Next, the insights into the hypothesised relationship between DCs and exploratory capabilities (H_3) that was

statistically supported in Chapter 5, are discussed. In doing so, how DCs could be related to the development and use of exploratory capabilities is examined.

First, by applying their transformative capability in innovation, the sample firms have acquired a higher level of manufacturing technologies and skills entirely new to the firm. Barney (1995) provides a classic example of the importance of exploring and developing new manufacturing technologies: as a result of not being able to recognise new opportunities and threats, USX, the steel manufacturer, delayed its investment in thin slab continuous casting steel manufacturing technology and failed whereas Nucor Steel who explored and identified the emerging opportunity and made these investments early became a major player in the steel industry. As the lead architect-hardware systems of firm O&C-4 put it:

> We have patents on the core technology and also some of the ways which technology can be applied. We also have a significant amount of intellectual property protected through trade secrets. Because, the thing with patents is if we publish, the minute we publish you are giving the competitors kind of how they might want to solve a problem...So trade secrets are more powerful than patents themselves. And we need to have a certain level of compliance protection. (Lead Architect-Hardware Systems, O&C-4)

Second, it was further revealed that building upon their exogeneous technologies, the firms have learnt product development skills and processes entirely new to the industry. Fang and Zou (2009) identify product development management as a key component of DCs related to marketing. Product development skills include skills in new concept screening to market launch (Day, 1994). The chief administrator of firm M&O-2 said:

> There are always different things we learn from our own technologies...We have moved away from just testing whether the ear is capable of hearing through looking at whether the ear has been degraded... We have a technology that allows us to compare the time of the performance of the hearing on a person...When you are treating people for things like cancer for example, some of the drugs can actually do damage to hearing system. To support that the ear may be monitored at the same time these drugs are being administered. So that you can improve the outcome of that particular patient. (Chief Administrator, M&O-2)

Third, by expanding their absorptive capability, the firms have developed a high level of capability in learning new skills in areas such as funding new technology, staffing R&D function, training and development of R&D, and engineering personnel for the first time. The marketing manager of firm M&O-3 explained:

> Up and till two years ago, R&D was not a key function. But we have recently had some new managers and we have expanded our R&D department to twice the size. And yes it is. It is certainly a key function now. (Marketing Manager, M&O-3)

Fourth, applying their transformative capability in innovation, the firms strengthened innovation skills in areas where it had no prior experience which is a clear indicator of their higher exploratory capabilities. Specially, radical innovation skill is a key characteristic of exploratory capabilities (Gilsing and Nooteboomb, 2006). The bioanalytics project manager of firm P&B-3 commented:

> Our business unit tends to provide a service to the customers. Everything we do can be very new and very bespoke. We sign over all work we do to the customer. So, should the benefit of being innovative for us, it is just to get more of these services. We don't patent them and try to make money of the patent to serve a customer. But, we have got some patents. Because, some of the things we do are worthy. (Bioanalytics Project Manager, P&B-3)

Fifth, as it emerged in the interviews, high-tech SMEs do not consider patents useful. However, as it was empirically established by Pilkington, Dyerson and Tissier (2002), in the context of large firms in the automobile industry, patents are a rich indicator of technological development. The high-tech SMEs believe that it is not worth holding patents due to high maintenance cost. In general, UK SMEs often face the pressures of cost and efficiency and therefore, they try to remain competitive by driving down costs rather than increasing value added (Harindranath, Dyerson and Barnes, 2008). Therefore, as far as the patents are concerned, the high-tech SMEs consider that cost of administering and getting approval is greater than the returns. In addition to the above claims by the senior executive from firm P&B-3, the chief administrator of firm M&O-2 reiterated this point:

> I should say the patents are pretty useless. Useless because the cost of administering and getting satisfied is greater than the opportunity we can make by selling the underlying technology. (Chief Administrator, M&O-2)

The above views are in agreement with Li, Vanhaverbeke and Schoenmakers (2008) who claim that new patents is only an intermediate output and what really matters is the successful introduction of new products or services in the markets. Therefore, number of patents may not be an effective indicator of transformative capability in innovation or exploratory capabilities of a firm.

Apart from the above evidence on how firms develop and use exploratory capabilities, the relationship between DCs and exploratory capabilities can be further explored in light of more qualitative data. The firms' explore using the DCs developed through creating and transforming innovative ideas through dedicated R&D staff. As the informant from firm M&O-2 described:

> Within the company, the process we followed was...the people formulate the ideas they want to make... As I said, I think we have about 35 staff. I would say probably the third of our staff is involved in research and development. (Chief Administrator, M&O-2)

Using their adaptive capability, firms have brought in or allocated additional resources for exploration. According to the marketing manager of firm M&O-3:

> Over the last four years, a series of new managers have been brought in to help existing managers or to replace in some cases... We also have...Basically, any profit or spare money goes towards new research equipment or new capacity. (Marketing Manager, M&O-3)

Thus, it seems that firms are making a conscious effort to develop their DCs that are focused on exploring new opportunities. The same informant from firm M&O-3 went on to say:

> I think I am responsible for finding areas that are not being addressed properly at the moment and developing products to fit in to those areas. (Marketing Manager, M&O-3)

Further evidence related to firms' DCs in adapting resources and developing unique technologies could be found. As claimed by bioanalytics project manager of firm P&B-3:

> But, also we try to compete by bringing in new technology with that you are able to use the simple technique that you can't get in India and China cheaply... Also, bringing in new members of the staff...That is the reason I was brought into the company because something I had a lot of experience... [It] is very difficult and lot of scientific knowledge is needed to interpret...Because, it is very very difficult for someone to give you the knowledge about the drug, you have to do it. (Bioanalytics Project Manager, P&B-3)

Overall, as demonstrated in the above analysis, the firms' capabilities in (based on Atuahene-Gima, 2005) (1) acquiring manufacturing technologies and skills entirely new to the firm, (2) learning product development skills and processes entirely new to the industry, (3) learning new skills in areas such as funding new technology, staffing R&D function, training and development of R&D, and engineering personnel for the first time, (4) strengthening innovation skills in areas where it had no prior experience are the sources and mechansisms of development and use of exploratory capabilities. In addition, it could be noticed that, (5) number of patents may not be an effective indicator of transformative innovative capabilities or exploratory capabilities of small firms. Thus, as it is evident in the analysis, the sources and mechanisms of development and use of exploratory capabilities of the sample firms are related to the DCs of those firms. In addition, the illustrative quotes also explain the relationship between DCs and exploratory capabilities of the high-tech SMEs. The above qualitative data also substantiate the moderately high mean score of 4.37 on those capabilities. Moreover, the resource constraints that have been mentioned in the illustrative quotes in the previous sections could be a reason for the high-tech SMEs not having a "high" level of exploratory capabilities, i.e. mean score of 5 to 7. On the other hand, the firms not being excessively focused on exploration is consistent with the moderate mean score on the success trap.

6.5.2. Dynamic Capabilities and Exploitative Capabilities of High Tech SMEs

As it was found in the quantitative data analysis, high-tech SMEs demonstrate a fairly high level of exploitative capabilities as shown by a mean score of 5.00. The qualitative findings on exploitative capabilities are presented mainly focusing on how firms refine and extend existing knowledge, skills and processes based on Atuahene-Gima (2005)

and what emerged in the data analysis. Next, the insights into the hypothesised relationship between DCs and exploitative capabilities (H_4) that was statistically supported in Chapter 5, is discussed. In doing so, how DCs could be related to the development and use of exploratory capabilities is explored.

First, using their transformative adaptive capabilities, high-tech SMEs upgrade their current knowledge and skills for familiar products and technologies by developing existing products and technologies. Bierly and Chakrabarti (1996) identified similar characteristics where it was found that exploiters are more into incremental learning where they just improve competitors' ideas, and are less into the development of radically new products. For example, the managing director of firm P&B-2 explained:

> ...when I talk about research and development, I often say we don't do much of the "R" here, but we do quite a lot of the "D". So, we don't do much cutting edge research for new things but we do develop a lot of stuff that we have or may be, we develop the things in licensed. (Managing Director, P&B-2)

Second, employing their transformative adaptive capability, the firms invest in enhancing skills in exploiting mature technologies that improve productivity of current innovation operations. The firms are more responsive to the customer and put an emphasis on marketing. It was stated that some firms spend large amount of resources on marketing as compared with what is spent on R&D and they focus on exploiting the existing market. Choi and Shpherd's (2004) study revealed that when entrepreneurial firms have perceived knowledge of customer demand for the product and also fully developed enabling technologies, they are likely to exploit opportunities. The following comments by the informants from firm Aero-2 and firm M&O-1 make this point clear:

> …it is very mature technology...the emphasis is on marketing. (Sales Engineer, Aero-2)

> We tend to focus on a product, whether there is a competitor or not already, and to exploit the existing market. (Managing Director, M&O-1)

Third, firms use their absorptive capability and enhance their competencies in searching for solutions to customer problems that are near to existing solutions rather than completely new solutions. Confirming this practice, the business development manager

of firm Aero-3 claimed: “It is looking at what is needed in the market and ensuring we have the products and the services to suit it” (Business Development Manager, Aero-3).

Fourth, building upon their existing transformative innovative capability, the qualitative data shows that the firms also upgrade their skills in product development processes in which the firm already possesses significant experience. As the business development manager of firm Aero-3 put it:

> We have been improving the management skills and we are mostly improving the products but we are also acquiring new products...Our focus is on improving what we do. (Business Development Manager, Aero-3)

Fifth, employing their existing transformative innovative capability, firms strengthen knowledge and skills for projects that improve efficiency of existing innovation activities, high-tech SMEs increase their exploitative capabilities. As the bioanalytics project manager of firm P&B-3 explained:

> ...we are looking for biosimilar drugs. But, they are actually the same class of drugs we have been looking at to innovate in that biological field. So, we are expanding to do the testing...All we are doing is expanding the different parts of the tests to offer our existing clients. (Bioanalytics Project Manager, P&B-3)

In addition, sixth, as emerged in the analysis, based on the market knowledge acquired through their absorptive capability, high-tech SMEs, particularly those who are more focused on the exploiting existing markets, tend to create niche markets where they can exploit their speciality. Saarenketo et al. (2004) and Qian and Li (2003) also report similar findings. The marketing manager from firm M&O-3 claimed that:

> ...we believe that a good deal of our success is due to the fact that we are specialists in one very small niche area. Rather than trying to be sort of all. (Marketing Manager, M&O-3)

Seventh, utilising their transformative innovative capability, firms also adopt a unique approach in marketing. This is largely driven by the small to medium size of the firms that gives an advantage over the large competitors. Gilmore, Carson and Grant (2001) maintain that with the SMEs become more experienced, marketing by networking will

be enhanced and improved. The lead architect-hardware systems of firm O&C-4 also revealed this practice: "Our marketing is based around customer case studies and customer success stories" (Lead Architect-Hardware Systems, O&C-4). In addition, in a niche market, marketing is different from conventional marketing. The executive chairman of firm O&C-2 explained this:

> We are a small company. In the B2B market in the industry where there are probably 30 customers in the world. So, marketing is not very important. (Executive Chairman, O&C-2)

Apart from the above evidence on the sources and mechanisms of development and use of exploitative capabilities of firms, the hypothesised relationship between DCs and exploitative capabilities that was supported in the statistical analysis in Chapter 5 is further explored next.The following illustrative quotes support the positive relationship between DCs and exploitative capabilities in high tech SMEs. The senior executives from Aero-2 and Aero-4 revealed how they use their transformative capability to exploit new markets: "We just adapt the core activity as we work in new markets" (Sales Engineer, Aero-2) and "We are going to improve what we have or possess" (Marketing Manager, Aero-4). Furthermore, the high-tech SMEs use their absorptive capability to exploit market opportunities. One informant claims that their firm "tend to focus on a product, whether there is a competitor or not already, and to exploit the existing market" (Managing Director, M&O-1). It was also evident in the interviews that firms acquire existing technologies and exploit the markets. As the marketing manager of firm M&O-3 put it:

> And actually not to have a machine [a technology developed 20 years ago] for 20 years was a big mistake. You know, three years ago we realised the mistake and developed a [the same technology] product. (Marketing Manager, M&O-3)

It could be observed that firms develop DCs not only through developing the existing staff but also through acquisitions. Those DCS are applied in exploiting markets: As an IT consultant of firm O&C-1 described:

> We train our staff. We invest a lot on training our people on new technologies. We send them for all the best training programmes, workshops etc. More importantly, we acquire resources and capabilities through acquisitions. (IT Consultant, O&C-1)

Firms focus on developing their capabilities that can be used in exploiting their core markets. The managing director of firm P&B-2 expressed these views:

> I think we are certainly aiming at becoming more responsive to the customer. So, we are changing our sales routes making quite a lot of investment into internet sales etc. Again, because we are a scientific company, a lot of our customers are very familiar with using the internet, websites. (Managing Director, P&B-2)

The positive relationship between DCs and exploitative capabilities that was supported by the quantitative and qualitative data, validates what Teece and Pisano (1994) said in introducing the DCs perspective:

> In attempting to explicate competitive advantage, the dynamic capabilities approach places emphasis on the firm's internal processes, assets and market positions, the path along which it has travelled, and the paths that lie ahead. The framework also explicitly takes into account replicability and imitatability (Teece and Pisano, 1994:554).

As it was understood in the above analysis, replicability and immutability are at the centre of exploitative capabilities of UK high-tech SMEs. It is evident in the analysis that the DCs and exploitative capabilities of high-tech SMEs have a positive relationship.

Thus, the findings of the above analysis reveal the following practices in developing and using exploitative capabilities of sample firms that are related to their DCs: (1) upgrading current knowledge and skills for familiar products and technologies, (2) investing in enhancing skills in exploiting mature technologies that improve productivity of current innovation operations, (3) enhancing competencies in searching for solutions to customer problems that are near to existing solutions rather than completely new solutions, (4) upgrading skills in product development processes in which the firm already possesses significant experience, (5) strengthening knowledge and skills for projects that improve efficiency of existing innovation activities (Practices 1-5 were identified based on Atuahene-Gima, 2005.), (6) high-tech SMEs focus more on the exploiting existing niche markets, and (7) they adopt a different approach in marketing (Practices 6-7 emerged in the qualitative data analysis.).The specific illustrative quotes also demonstrate how exploitative capabilities that are influenced by the DCs of high-tech firms.

In general, the firms demonstrate a moderate level of exploratory capabilities and a high level of exploitative capabilities that are influenced by their DCs. It seems that the firms particularly apply their absorptive capability in acquiring knowledge on market opportunities where they explore opportunities and they use their transformative capability in exploiting such market opportunities by adapting available products and technologies.

6.5.3. Exploratory Capabilities and Exploitative Capabilities

The hypothesised correlation between exploratory and exploitative capabilities (H_5) is further examined in the qualitative stage. The qualitative findings substantiate the positive correlation between the two constructs that were supported by the quantitative findings in Chapter 5.

As the informant from firm M&O-3 claimed:

> I think I am responsible for finding areas that are not being addressed properly at the moment and developing products to fit into those areas. (Marketing Manager, M&O-3).

This highlights the effect of exploratory capabilities on exploitation capabilities of the firms. It was also found that the firms with radically new technologies that are patented face the problem of competitors infringing their patents. This forces the firms to talk to those competitors or to take legal actions. More importantly, this forces them to exploit their innovations faster than the competitors. For example, as the research director of firm O&C-5 explained:

> One of our competitors has now started doing sort of gold rush marketing approach and, I can't say very much about it. You know, we are sort of responding to that. (Research Director, firm O&C-5)

On the other hand, firms' exploratory capabilities are influenced by their exploitative capabilities. As the informant from firm O&C-3 described they focus on the existing market i.e. start-up businesses' problems, and "help them find out what problems are and what the best solutions are and integrate into existing systems and products" (Managing Director, O&C-3). Thus, such a customer driven approach can lead to radical solutions. In addition, the cash generated through exploitation of existing

opportunities can be channelled for developing exploration capabilities. For example, as the finance director of firm RT&C-2 put it:

> We haven't got major finance in the company to support anything other than getting interesting business. (Finance Director, RT&C-2)

Thus, resources invested in exploitation will generate the resources needed for exploration of new opportunities. The marketing manager of firm M&O-3 reiterated this relationship:

> Basically, any profit or spare money goes toward new research equipment or new capacity. (Marketing Manager, M&O-3)

The above findings suggest a co-evolutionary relationship between the two types of entrepreneurial capabilities. Thus, the findings support Zollo and Winter's (2002) argument that exploration leads to exploitation and could feed back into a new exploration phase. In addition, in the context of high-tech SMEs, substantiating Greve's (2007) findings, the famous trade-off between exploration and exploitation (March, 1991) is not supported by the qualitative data.

6.6. Entrepreneurial Capabilities and Firm Performance

Firm performance reported a mean score of 4.44 in Chapter 5 indicating a moderate level of performance among the high-tech SMEs. Firm performance was assessed focusing on both financial and non-financial dimensions. Therefore, the interview data were also analysed along those two dimensions. The financial performance was assessed by asking the interviewers to comment on the sales and profitability of their firms from 2008 to 2010/2011 comparing those with their competitors and/ or their own performance.

He and Wong (2006) claim that high-tech firms tend to achieve higher sales growth rates. The interview findings report that the sample high-tech SMEs experienced a growth in sales over the period under consideration. This could be observed across different industries. For example, the sales engineer of firm Aero-2 claimed "Yes. I think we are OK. Something like 20-30% [sales growth]". The managing director of firm P&B-1 said "In terms of sales over the last 5 years, the last 2 years, it has probably

gone up 5 percent a year". More evidence could be found from the informant from firm RT&C-3: "in 2010, about 10% [sales growth] actually" (Commercial Manager, RT&C-3).

Some other firms claimed that they have experienced a growth and then over the last year the sales performance has been slowed down or flat. The managing director of firm P&B-2 openly attributed the situation to current economic downturn while others did not have any reason for the saturated sales revenue. However, they were developing strategies such as niche market operations that was mentioned earlier, to cope with the slow growth. For example, senior executives from firms Aero-3 and P&B-2 shared the following views:

> Last year we grew about 5%. But, previous years we grew over 25% per year. (Business Development Manager, Aero-3)

> We had a big jump in sales in 2008 to 2009. Probably, about 10% growth. 2009 to 2010 was fairly flat. That was a small growth...Sales growth is relatively slow at the moment. But, that is slowing in the general market place with the economy. (Managing Director, P&B-2)

Annual Small Business Survey 2006/07 (BERR, 2008b) reports that among UK SMEs, only 40% experienced growth in turnover. However, the above data on UK high-tech SMEs indicate a positive growth among the firms studied.

As far as the profitability of the UK high-tech SMEs is concerned, there were many cases of growth across all the high-tech industries studied. As the managing director of firm P&B-1 claimed the profitability has increased as a result of exploiting existing products:

> Profitability in the last 12 months, the profit margins have gone up. Because, we think we are selling more generics, our own generics. So, we have a better profit margin in that. (Managing Director, P&B-1)

Many other firms reported a growth in their profits. The firms who have passed their investment mode are now exploiting their radical innovations. As the chief executive officer of firm P&B-4 claimed, "Profitability has increased about the same (20%) because, our margins are the same".

Firms in high-tech industries can, on average, experience only modest growth due to 'innovativeness' and they may grow for a number of other reasons (Coada and Rao, 2008). Firms from different high-tech industries claimed that their performance has been flat over the years. The sales engineer of Aero-2 said "No it [the profitability] has been the same". This similar trend was reported by the sales director of firm RT&C-1: "The profitability is the same sort of margin. This is one of the things we need to improve".

The people hired, most probably as support staff, to exploit their previous radical innovations during the hay day of those innovations can become a burden on the firm in later stages of the product life cycle. However, as far as the human capital of high-tech SMEs is concerned, what is important is the founders' human capital that is positively related to growth (Colombo and Grilli, 2005). There were complaints of high human resource overhead:

> We are maintaining the same level of profitability [the firm continue to make profit] but there is an increased of cost of running a bigger staff. (M&O-2 Chief Administrator)

Some other SMEs reported a decrease in profitability: for example, the bioanalytics project manager of firm P&B-3 revealed that even though the sales have increased, this growth does not reflect in profitability of firms.

> In 2009 a peak year and 2010 and 2011, it has been more challenging for the firm. I think we are making more turnover in this year than we have made before, but profit is down. (Bioanalytics Project Manager, P&B-3)

However, there were exceptions where some firms were recovering from a decrease in their profits. As the research director of firm O&C-5 explained:

> We are not profitable at the moment. I think we lost in 2008 a million, and in 2009 half a million and I think 2010 the loss was about £100000. We are hoping to make profits in this year. (Research Director, O&C-5)

Some firms are still in the investment mode and it is quite common in highly innovative industries to spend years exploring radical technologies: "This firm is still in investment mode. It is not profitable because it is pretty young. It is doing OK" (Executive

Chairman, O&C-2). However, according to Coada and Rao (2008), even if a firm invests in R&D but does not make a discovery, the firm may rapidly lose its market share to its competitors; therefore, in highly innovative sectors, firms can never be certain about their performance in future.

As suggested by the above findings, the majority of the high-tech SMEs report a moderate growth or stable performance in sales and/or profitability.

Non-financial performance of the firms was assessed based on the change in number of employees and the size of the premises of the firms. As far as the change in number of employees over the period 2008-2011 is concerned, firms in different industries reported a growth in number of employees. For example, the informants from firms Aero-3, P&B-3, and RT&C-1 claimed:

> We have increased by about 25%. (Business Development Manager, Aero-3)

> In 2009, I think there were 35. And now there are 55. (P&B-3 Bioanalytics Project Manager, P&B-3)

> It probably has 10 percent but it already has 120 and it has been over the last few years. (RT&C-1 Sales Director, RT&C-1)

Some high-tech SMEs reported that the number of employees have been flat over the period under consideration that could be due to the current economic condition in the UK. As explained by the informants from firms P&B-2 and O&C-1:

> In 2006, we would have been about 60 employees. So, we are now about 80. We have probably got about 85. We are pretty stable at the moment. (Managing Director, P&B-2)

> The number of employees has been quite stable. We hired 25 employees in 2010. (O&C-1 IT Consultant, O&C-1)

Firms have laid off the staff and they believe that it has increased the efficiency of firms. The marketing manager of firm Aero-4 revealed this fact: "To be honest, it has actually gone down finally as result of process improvements".

Employment growth is a significant indicator of SME growth in general (Robson and Bennett, 2000). The Annual Small Business Survey 2006/07 (BERR, 2008b) reports that, among UK SMEs, only 20% of SME employers experienced employment growth in 2006/2007. Furthermore, Cosh et al. (2009) found that among UK SMEs, 18% reported a decrease, 76% reported no change, and 5% reported an increase in the level of employment in 2009. However, the above qualitative data indicate a positive growth in the number of employees among UK high-tech SMEs.

With regard to the change in the size of the premises, the other indicator of non-financial performance of high-tech SMEs, it was reported that there was an increase despite the current economic condition. For example, informants from firms Aero-1 and M&O-3 said:

> Well, end of 2008 we had a small laboratory of may be 120 square feet. And then we had a facility in addition to that 1500 square feet. (Chief Executive Officer, Aero-1)

> [Size of the premises] certainly increased. Well, I mean in 2009, we had spare capacity in the premises. This year we are running out of spare capacity and we are heading to do some building work to increase the capacity. (Marketing Manager, M&O-3)

Some other firms have been operating in the same premises for years. The managing director and commercial manager of firm P&B-1 claimed that "Size of the premises in 2009, same". The research director of firm O&C-5 also reported that "the size of the premises has remained pretty static". The informant from RT&C-1 claimed that they have reduced the space but the efficiency has increased:

> No. The actual area that we now employing with the brand new factory has probably shrunk slightly. Moving factories enable us to make two factories into one has greatly utilization has improved dramatically and we are efficient than ever before. (Sales Director, RT&C-1)

The above findings indicate that, overall, there is a growth in the performance of high-tech SMEs in both financial and non-financial dimensions using their exploitative capabilities. The firms managed to maintain a moderate level of performance over the three years period from 2008 to 2010 despite the current economic downturn. Another reason for the above moderate performance of high-tech SMEs could be due to their

single product focus and niche market character (Hoffman et al., 1998). The qualitative data supports the quantitative findings that reported a firm performance mean score of 4.44.

6.6.1. Exploratory Capabilities and Firm Performance

This section provides further insights into the hypothesised positive relationship between exploratory capabilities and firm performance (H_6) that was statistically supported in Chapter 5. In doing so, the effect of exploratory capability on firm performance is discussed focusing on the practices related to exploratory capabilities that were identified earlier.

Boyer et al. (1997) found that investments in advanced manufacturing technologies and manufacturing infrastructure are positively correlated with firm performance in general. For example, as it was described by the informant from firm O&C-4, they have developed a radically new manufacturing technology that is patented. In addition, they maintain their trade secrets as well. When it comes to the performance of the firm O&C-4, over the past three year or more, the firm has been rated as one of the fastest growing firms in the UK.

> The main measure is it is always better to have a look at the tangible things you need to measure. So last three years, we have been in the [an international consultancy firm's rating list] fastest growing companies in the UK. We have been highly placed in that. So, we are growing rapidly. (Lead Architect-Hardware Systems, O&C-4)

The qualitative data show that UK high-tech SMEs have learnt product development skills and processes entirely new to the industry. As it was empirically established in Wolff and Pett's (2006) study of entrepreneurial firms and SMEs in the manufacturing industry, the product improvement orientation of firms was found to be positively associated with firm growth and profitability. This could be observed in the interviews as well. For example, according to the chief administrator of firm M&O-2, they keep learning product development skills and processes entirely new to the industry:

> What we aim to do is to have at least one of our new products coming in to the marketplace. So, that is the top of its peak. It is following the run off of the older product. So, it cyclically operates. (Chief Administrator, M&O-2)

As a result of the above approach that helps explore and learn radically new product development skills and processes, the firm continue to make profits: "We continue to make profit. We continue to plough out those profits into R&D" (M&O-2 Chief Administrator). Thus, the findings suggest that learning radically new product development skills and processes improves firm performance.

Evidence show that the high-tech SMEs have developed their skills in R&D. Oakey (1984) conclude that R&D commitment of small high-tech firms significantly contribute to their innovation and as compared with the role of internal R&D, other external sources of technical information were found insignificant. Furthermore, the high R&D cost of those firms was reflected in their research commitments ranging from part-time effort of a single key innovator, to the full-time efforts of several engineers in a R&D department (Oakey, 1984). For example, as presented above, firms M&O-3 that demonstrate a high level of capability in learning new skills in areas such as funding new technology, staffing R&D function, training and development of R&D, and engineering personnel reports a continuous growth over the period under consideration.

> In 2009, we won the Queen's Award in the industry for exports achievements, which means that we had grown frequently for 7 years minimum. So, from 2007, every year we grew our turnover. In the last three years, every year we have increased our sales by between 5% and 10%, which compared to some of the firms in the market is very pleasing. (Marketing Manager, M&O-3)

As illustrated above firm M&O-3 have grown at rate of 5%-10% for over 7 years indicating that firms have maintained a high growth rate. Thus, it is clear that firms' level of capability in learning new skills has positive effect on their firm performance.

In addition, strengthening innovation skills in areas where it had no prior experience improves performance of high-tech SMEs. Related findings have been reported in the literature. For example, Thornhill (2006) found that as compared with low-tech SMEs, high-tech SMEs introduce a higher percentage of radically new products and their innovation skills have a positive influence on firm performance. The UK high-tech SMEs have also been strengthening innovation skills in areas where it had no prior experience. The illustrative firms (e.g. Aero-1 and P&B-3) who demonstrate innovative skills in developing new technologies and creating new markets report sales growth up

to a certain point and then a flat sales performance or a slowdown in profits that may have caused by the current economic downturn. For example, the informant from firm P&B-3 said:

> 2009, a peak year, and in 2010 and 2011, it has been more challenging for the firm. I think we are making more turnover in this year than we have made before, but profit is down. (Bioanalytics Project Manager, P&B-3)

The above findings and other empirical and theoretical evidence found in the literature show that the exploratory capabilities have a positive effect on the firm performance of UK high-tech SMEs. These findings support those of the quantitative analysis that supported the hypothesised positive relationship between exploratory capabilities and firm performance. In addition to that, it could be found that UK high-tech SMEs, in general, do not consider patents as something worth maintaining due to the cost and also the disadvantages of publishing their radical innovations that could be misappropriated by competitors.

6.6.2. Exploitative Capabilities and Firm Performance

This section provides further insights into the hypothesised positive relationship between exploitative capabilities and firm performance (H_7) that was statistically supported in Chapter 5. In doing so, the role of practices related to exploitative capabilities in achieving differential firm performance is examined.

Upgrading current knowledge and skills for familiar products and technologies would enhance firm performance. Thornhill's (2006) study of manufacturing firms reveals that the level of knowledge assets within a high-tech firm affects the quality of its innovations indicated by its revenue growth. The interview responses show how the high-tech SMEs' approach of upgrading their current knowledge and skills for familiar products and technologies by developing existing products and technologies increase their firm performance, particularly in the short run (e.g. firm P&B-2).

Furthermore, investing in enhancing skills in exploiting mature technologies that improve productivity of current innovation operations can contribute to increased firm performance. Canon's introduction of the proximity aligner which was not a radical advance in technology but a minor conceptual change was partly responsible for the

failure of its competitor Kasper Instruments who used to be a profitable firm in late 1960s and early 1970s (Henderson and Clark, 1990).Thus, by exploiting the existing technology Canon could take over the market. Empirical evidence supporting this relationship was found in the qualitative stage. As claimed by the informants from illustrative firms Aero-2 and P&B-2, enhancing skills in exploiting mature technologies has improved firm performance. However, the growth was significant in the early stage.

In addition, enhancing competencies in searching for solutions to customer problems that are near to existing solutions has a positive effect on firm performance. Due to the expertise firms have already developed in existing markets and customers, developing solutions to customer problems that are near to existing solutions decreases the chance of costly failures and in turn, have a positive effect on firm performance (Atuahene-Gima et al., 2005). Similar comments could be heard in the interviews. For example, as presented earlier, according to the informant from firm Aero-3, the firm studies customer need in the market and offer products and services to suit it adapting the broad range of technologies the firm has.

> "The advantages [the firm has] were the innovative nature of our people and the broad range of technologies we have". (Business Development Manager, Aero-3)

Furthermore, as it was claimed by the interviewee from firm O&C-3, the firm offers solutions to customer problems that are integrated into existing systems and products. Both the firms have reported a growth in their performance indicating the positive effect of their approach in dealing with customer needs by adapting existing solutions.

It was also evident that the firms who upgrade their skills in product development processes in which the firm already possesses significant experience also report a growth in their firm performance. The case study of Scandinavian PC Systems by Holmqvist (2004) reveals that adopting an approach that include product development skills, based on learning from experience to produce PC programs, the company successfully exploited over the years, helped become Sweden's leading provider of administrative personal computer programs. For example, firm Aero-3 who adopts a similar approach and mostly improves the existing products, as mentioned above, reports a growth in firm performance.

Strengthening knowledge and skills for projects that improve efficiency of existing innovation activities lead to better firm performance. Particularly, in highly competitive environments, exploiting existing innovations improve firm performance (Jansen, Van den Bosch and Volberda, 2005b and 2006). The increased exploitative capabilities through strengthening knowledge and skills for projects that improve efficiency of existing innovation activities have helped high-tech SMEs improve their performance. However, as it was reflected in the illustrative quotes from the informants from firm P&B-3, it has been challenging for firms to maintain profitability, probably due to the current economic downturn.

The above findings of the qualitative data analysis substantiate the findings of the quantitative data analysis that supported the hypothesised positive relationship between exploitative capabilities and firm performance of UK high-tech SMEs. In addition, highlighting the characteristics of the original definition of the construct exploitation (March, 1991), it could be observed in the qualitative data analysis that the exploitative capabilities have a short-term effect on firm performance.

6.6. Summary

This chapter reported the findings of the qualitative data analysis. The findings reveal that the market environment of high-tech SMEs is quite stable due to their focus on niche operations and their unique technologies that minimise the threat of competition. On the other hand, the firms demonstrate a high level of DCs, both absorptive and transformative capabilities, that has been achieved through strong networks with different parties that help maintain a stable knowledge in-flow and such knowledge is assimilated into the knowledge existing in firms using formal as well as informal mechanisms, adapting and innovating products, processes and technologies. Thus, high absorptive capability and transformative capability of firms seem to be driven by the unique nature of their business and not by the moderately dynamic market.

In addition, it was observed that the firms included in the qualitative study are also naturally innovative and they are in the business due to their high level of DCs. The UK high-tech SMEs are not trapped in the success trap to a significant extent and learning takes place in those firms that helps the firms to develop new capabilities. Thus, the moderate level of the success trap seems to be associated with the high level DCs of those firms.

As it was shown by the level of technologies and skills acquired/developed in the areas of manufacturing, R&D etc that are entirely new, the UK high-tech SMEs maintain a moderate level of exploratory capabilities. In addition, as it was revealed in the analysis, number of patents may not be a good indicator of exploratory capabilities of any UK high-tech SME. The firms' exploring using the DCs developed through creating and transforming innovative ideas through dedicated R&D staff, bringing in or allocating additional resources for exploration, making a conscious effort to develop their DCs focused on exploring new opportunities, demonstrating DCs in adapting resources and developing unique technologies confirm the positive role played by DCs in enhancing the exploratory capabilities of the high-tech SMEs.

UK high-tech SMEs' capabilities in upgrading knowledge and skills for familiar products and technologies, in using mature technologies in searching for solutions near to existing solutions, in adopting familiar product development processes, and in implementing projects that improve efficiency, and also their increased focus on the exploiting existing niche markets, and their tendency to adopt an unconventional approach in marketing indicate the presence of exploitative capabilities in UK high-tech SMEs. In addition to that, the qualitative findings confirm the positive relationship between DCs and exploitative capabilities in high tech SMEs. It seems that the firms use their absorptive capability to explore new market opportunities and transformative capabilities to exploit such opportunities. It could also be observed that firms develop DCs not only through developing the existing staff but also through acquisitions. Furthermore, firms focus on developing their capabilities to exploit their core markets.

The findings also confirm that the exploratory capabilities and exploitative capabilities have a co-evolutionary relationship. As it was mentioned above, the firms possess exploratory capabilities and it could be further established that those capabilities contribute to firm performance. On the other hand, UK high-tech SMEs demonstrate exploitative capabilities that result in increased firm performance, particularly, in the short run.

Chapter 7: Discussion

7.1. Introduction

This study was aimed at understanding the antecedents and consequences of DCs and entrepreneurial capabilities. It was particularly focused on examining how firms develop and use DCs and their effect on firms' entrepreneurial capabilities and in turn the effect of entrepreneurial capabilities on firm performance. This chapter discusses the findings of the quantitative data analysis reported in Chapter 5 and the findings of the qualitative data analysis presented in Chapter 6.

7.2. The Success Trap and Dynamic Capabilities

Firms may fall into the success trap as they stick to the same set of capabilities for a long time (e.g. Ahuja and Lampert, 2001; Leonardo-Barton, 1992; Levinthal and March, 1993). Based on March's (1991) conceptualisation and Ahuja and Lampert's (2001) findings on the negative effect of the success trap on breakthrough inventions in large corporations, this study examined the negative effect of the success trap on DCs. The quantitative findings supported the hypothesised negative relationship between the success trap and DCs ($\beta = -0.35$, $p < 0.01$). These findings also corroborate with the conceptual and empirical evidence available in the literature.

Past researchers have reported the effect of the success trap on capability development in firms that support the above findings. The need for change of capabilities may arise from changes in organisational conditions rather than in the external environment (Zahra, Sapienza and Davidson, 2006) that is confirmed by the findings of relevant empirical studies. It has been found that the institutional factors can play a role in promoting or hindering DCs of firms (Delmas, 2002). For example, capability building takes place through learning processes (Keli, 2004). Furthermore, when firms explore organisational and technological boundaries, they tend to report technological development beyond the existing domain (Rosenkopf and Nerkar, 2001). However, the above studies were limited to few case studies of large firms or to a particular industry. Therefore, the findings of the large sample survey of this study that supports the negative effect of the success trap on DCs extends the existing literature.

Complementing the above findings, the qualitative data shows that the high-tech SMEs may fall into the success trap due to reasons that were identified based on Ahuja and

Lampert's (2001) work, such as (1) the tendency to adopt technology that is familiar to the firm caused by resource constraints, comfort, customer-focus, (2) tendency to adopt mature technology in the industry because of difficulty in getting to the market, the perception that it is the nature of the SME's business, and (3) tendency to look for technologies that are near to existing technologies that is resulted by inability to understand the market needs, reluctance to take the risk, the belief that firms can innovate while adopting the established core technology, and over reliance on feedback from current customers.

Given the limited financial resources and risk-bearing capability, SMEs are vulnerable to be caught in the success trap (Liao, Welsch and Stoica, 2003). However, the moderately high levels of exploratory capabilities (mean score = 4.37) and exploitative capabilities (mean score = 5.00) as it was evident by the quantitative data indicate some level of ambidexterity (O'Reilly and Tushman, 2008) in the high-tech SMEs. This also validates the moderately low level of the success trap (mean score = 3.67) and consequently, high level of DCs (mean score = 5.36) in those firms. As the qualitative findings suggest, by driving change and setting the boundaries of technologies, developing expertise within the firms in developing firms' own technologies, making it fundamental for people to create as it is a part of firm's existence, and thriving in the industry by being more dynamic and staying ahead of the competition, UK high-tech SMEs have been able to control the risk of falling in to the success trap and in turn, to develop DCs.

Even though prior researchers have pointed out the danger of learning traps, success traps and competence traps (Ahuja and Lampert, 2001; March, 1991; Levinthal and March, 1993), no systematic evidence exists to gauge the effect of the success trap on DCs. This study is the first to examine the direct effect of the success trap on the development and application of DCs that found a strong negative effect. This confirms that firms' ability to avoid being trapped in their own success is crucial to their ability to strategically renew their resource-base and create new organisational resources and capabilities.

7.3. Market Dynamism and Dynamic Capabilities

Challenging the dominant idea that DCs are determined by market dynamism (e.g. Cui, Griffith and Cavusgil, 2005; Lavie, 2006; Tripsas, 1997; Volberda, 1996; Zahra,

Sapienza and Davidson, 2006), the results of the statistical analysis did not support the hypothesised positive relationship between market dynamism and DCs ($\beta = 0.00$, i.e. -0.003, $p > 0.05$). This contradicts the findings of some of the past studies. For example, Tripsas (1997) found that radical, competence destroying technological change, which is an element of the market dynamism, affected DCs of firms in the type setter industry. Cui, Griffith and Cavusgil (2005) reported a strong correlation between market dynamism and knowledge management capabilities that partly demonstrate absorptive capability of firms. However, limitations of those studies reduce their generalisability: Tripsas's (1997) study was limited to three cases of leading firms in the type-setter industry in 1980s whereas Cui, Griffith and Cavusgil (2005) acknowledged that their measurement of knowledge management capabilities may not have fully captured the construct. Furthermore, a recent survey study by Pavlou and El Sawy (2011) reveals that, particularly in higher levels of environmental turbulence, DCs can influence performance in new product development by reconfiguring firms' operational capabilities.

The above findings support the Zollo and Winter's (2002) critique on the definition of DCs by Teece, Pisano and Schuen (1997) which highlights the need for the presence of "rapidly changing environments" for the existence of DCs. However, "firms obviously do integrate, build, and reconfigure their competencies even in environments subject to lower rates of change" (Zollo and Winter, 2002: 340). In addition, Eisenhardt and Martin (2000) maintain that DCs can also operate in relatively stable environments. Therefore, Ambrosini and Bowman (2009) propose that "incremental" development of existing resources could also be viewed as DCs. Thus, the findings of this study confirm that firms can develop DCs irrespective of the level of market dynamism, particularly in the context of high-tech SMEs. Similar findings have been reported in related research. For example, Miller and Friesen (1983) found that the relationship between environmental hostility and innovation was negative for Canadian firms whilst being positive for US firms. This also suggest that environmental hostility does not have any simple relationship to innovation and it may depend on the state of the firm's resources and the nature of competitive threats (Miller and Friesen, 1983).Their findings were mainly related to innovative capability which is a component of DCs. Another recent survey study by Protogerou, Caloghirou and Lioukas (2011) confirm that DCs can have a positive effect on operational capabilities and firm performance even in less dynamic environments. These findings also confirm that DCs can be identified regardless of

market dynamism (Protogerou, Caloghirou and Lioukas, 2011). Therefore, the current findings on the total construct of DCs further extend the knowledge of market dynamism and DCs relationship.

The measure of market dynamism for this study that was adapted from Atuahene-Gima (2005) is based on Jaworski and Kohli (1993). Therefore, the above results could have been suffered from the limitations of small sample size or low reliability of the measures, as acknowledged by Jaworski and Kohli (1993) in their original study where they used the original measures.

Nevertheless, the findings of qualitative data analysis provide convincing insights in to the results of the statistical test of the above hypothesised relationship between market dynamism and DCs that was not statistically significant. The findings suggest that UK high-tech SMEs are focused on niche market operations (Saarenketo et al., 2004) that give them more control over the change in customer behaviour. It was also found that the firms are naturally high-tech and they deal with core technologies that were originally developed and controlled by themselves. Furthermore, the effect of changes in technology can depend on the firm's industrial sector and the way firms perceive technological change and how they deal with it (Julien et al., 1999). Overall, firms initiate changes in the unique technology they adopt and consequently possess the capabilities in predicting the changes in technological trajectory. As far as the competition is concerned, the findings reveal that, in most cases, the availability of a limited number of competitors in the market who firms know very well, gives them better ability to predict competitor moves. Thus, the insights of the qualitative findings confirm that development and use of DCs in UK high-tech SMEs are not entirely driven by market dynamism.

7.4. Dynamic Capabilities and Exploratory Capabilities

The findings of the quantitative data analysis supported the hypothesised positive relationship between DCs and exploratory capabilities of UK high-tech SMEs ($\beta = 0.52$, $p < 0.001$).

The above findings are also consistent with what is reported in extant literature. Firms must build DCs to sustain product innovation (Verona and Ravasi, 2003) that demonstrates their exploratory capabilities. Furthermore, strategic flexibility (or

adaptive capability which is a component of DCs according to Wang and Ahmed, 2007) strengthens the positive effect of technological capability and exploration in high-tech firms (Zhou and Wu, 2010). Thus, the above findings of the study substantiate the findings of both qualitative (e.g. the case study by Verona and Ravasi, 2003) and quantitative (e.g. the large sample survey by Zhou and Wu, 2010) studies available in the literature.

In addition, the qualitative findings also support the positive effect of DCs on exploratory capabilities of high-tech SMEs. The firms use the DCs developed through creating and transforming innovative ideas through dedicated R&D staff to explore new technologies. Their adaptive capabilities help the firms find additional resources for exploration, for example, in developing unique technologies.

7.5. Dynamic Capabilities and Exploitative Capabilities

The findings of the quantitative data analysis supported the hypothesised positive effect of DCs on exploitative capabilities of high-tech SMEs ($\beta = 0.49$, $p < 0.001$). Exploitative capabilities encompass capabilities in refining, implementing, increasing efficiency, producing and selecting (He and Wong, 2004:481). The positive effect of DCs on exploitative capabilities of firms has been proposed in conceptual work. For example, Dacko et al. (2008) identified four types of DCs, i.e. dynamic marketing capabilities, dynamic research and development capabilities, flexible manufacturing capabilities, and flexible financial capabilities that could influence a firm's readiness for exploiting existing and new technologies. In addition, Zahra, Filatotchev and Wright (2009) suggest that absorptive capacity fuels corporate entrepreneurial activities. Those activities mainly include exploratory capabilities and exploitative capabilities (Arthurs and Busenitz, 2006; Shane and Venkataraman, 2000). The findings also corroborate with empirical work reported in the extant literature. Ellonen, Wikström and Jantunen (2009) found that strong DCs enable the firm to react to market and technological opportunities, weak DCs might restrain it from reacting to those opportunities. Since those findings are based on four case firms in the publishing industry, the findings of this study enhance the validity of the empirical support for the effect of DCs on exploitative capabilities.

7.6. Exploratory Capabilities and Exploitative Capabilities

The findings of the quantitative data analysis supported the hypothesised positive correlation between exploratory capabilities and exploitative capabilities, i.e. H_5 ($r = 0.50$, $p < 0.01$). Exploratory capabilities include capabilities in searching, discovering, experimenting, risk taking, and innovating whereas exploitative capabilities encompass capabilities in refining, implementing, increasing efficiency, producing, and selecting (He and Wong, 2004).

Suggesting a co-evolutionary relationship between the two types of entrepreneurial capabilities, the findings support Zollo and Winter's (2002) argument that exploration leads to exploitation and could feed back into a new exploration phase. In addition, the study substantiates Greve's (2007) findings where the famous trade-off between exploration and exploitation (March, 1991) was not supported.

In addition, the findings of the qualitative data analysis also provide insights into the positive correlation between exploitative capabilities and exploratory capabilities. The firms with patented radically new technologies tend to develop exploitation capabilities to avoid the problem of competitors infringing their patents and exploiting their innovations. On the other hand, the exploitative capabilities applied in a customer driven approach can result in higher exploratory capabilities leading to radical solutions. In agreement with Lubtakin et al. (2006), it could be noticed that due to lack of resources, the high-tech SMEs find it difficult to manage separate units for exploration and exploitation as in the case of structural ambidexterity. The firms rather focus on creating a context which helps achieve contextual ambidexterity (Gibson and Birikinshaw, 2004) that is led by the top managers of the firms (Lubtakin et al., 2006).

7.7. Exploratory Capabilities and Firm Performance

Exploratory capabilities are a key component of entrepreneurial capabilities of firms (Arthurs and Busenitz, 2006; Shane and Venkataraman, 2000). The findings of the quantitative data analysis support the hypothesised positive effect of exploratory capabilities on firm performance (H_6) of high-tech SMEs ($\beta = 0.21$, $p < 0.05$). The empirical evidence found in the extant literature supports this finding. For example, Wiklund and Shepherd (2003) report that knowledge-based resources that are applicable to exploration (and exploitation) of opportunities have a positive influence on firm performance that is moderated by firm entrepreneurial orientation. Furthermore,

exploration is considered to be more positively associated with effective firm performance than exploitation (Auh and Menguc, 2005), and exploration has a greater positive impact on long-term performance of SMEs (Isobe, Shige and Montgomery, 2004). McGrath (2001) confirm that the degree of exploration does matter and suggest the importance of including the construct in explaining strategic performance of firms. All the above findings are derived mostly from large sample survey. Thus, this study also extends those findings by confirming the positive effect of exploratory capabilities on firm performance.

The findings of the qualitative data analysis also provide insights into the positive effect of exploratory capabilities on firm performance. Qualitative evidence shows that those high-tech SMEs who develop radically new manufacturing technologies, report a better performance (Boyer et al., 1997). The high-tech firms also keep learning product development skills and processes entirely new to the industry and they have achieved increased performance (Wolff and Pett, 2006). Furthermore, confirming the findings by Oakey (1984), firms who demonstrate a high level of capability in learning new skills in areas such as funding new technology, staffing R&D function, training and development of R&D, and engineering personnel for the first time report a continuous growth. Thus, the qualitative findings also substantiate the quantitative findings.

7.8. Exploitative Capabilities and Firm Performance

Exploitative capabilities are the other key component of entrepreneurial capabilities of firms (Arthurs and Busenitz, 2006; Shane and Venkataraman, 2000). The findings of the quantitative data analysis supported the hypothesised positive effect of exploitative capabilities on firm performance (H_7) of high-tech SMEs ($\beta = 0.22$, $p < 0.05$).

Similar results have been reported in the extant literature. Auh and Menguc (2005) concluded that exploitation was positively related to efficient firm performance of prospector firms of Miles and Snow (1978) strategy typology. Furthermore, exploitation has a greater positive impact on short-term performance of the firms (Isobe, Shige and Montgomery, 2004). In addition, the relative amount of exploration and firm financial performance can be a curvilinear relationship that is positively moderated by the R&D intensity (Uotila et al., 2009). Both exploration and exploitation orientations contribute uniquely to overall firm performance of SMEs (Lubatkin et al., 2006).

The findings of the qualitative data analysis provide further insights into the relationship between exploitative capabilities and firm performance. The high-tech SMEs' approach of upgrading their current knowledge and skills for familiar products and technologies by developing existing products and technologies has resulted in an increase in firm performance, particularly in the short run (Thornhill, 2006). Furthermore, enhancing skills in exploiting mature technologies has improved firm performance. However, overall, the growth was significant in the early stage (Henderson and Clark, 1990). In addition, the firms study customer need in the market and offer products and services to suit it adapting the broad range of technologies the firm possess and also offers solutions to customer problems that are integrated into existing systems and products. These practices decrease the chance of costly failures and thereby have a positive effect on firm performance (Atuahene-Gima, Slater and Olson, 2005). Similar to the findings by Holmqvist (2004), by improving the existing products, as mentioned above, the high-tech SMEs have achieved a growth in their performance. Even though, it has been challenging for the firms to maintain profitability, probably due to the current economic downturn, substantiating the findings by (Jansen, Van den Bosch and Volberda, 2005b and 2006), it was found that the high-tech SMEs have improved their performance by exploiting existing innovations. Thus, the qualitative data supports the above findings of the quantitative data analysis. As mentioned earlier, the effect of exploratory capabilities may be mainly on the short-term performance of the firms.

7.9. Summary

This chapter discussed the findings of the quantitative data analysis supported with the findings of the quantitative data analysis. It was reported that the success trap has a significant negative effect on DCs (H_1) of the firms. It was also found that market dynamism is not a significant antecedent of DCs of UK high-tech SMEs (H_2). Furthermore, it could be established that DCs have a significant positive effect on exploratory capabilities (H_3) and also on exploitative capabilities (H_4) of UK high-tech SMEs. The quantitative data supported the hypothesised a positive correlation between exploratory capabilities and exploitative capabilities (H_5). Moreover, the hypothesised positive effect of exploratory capabilities on firm performance (H_6) and hypothesised positive effect of exploitative capabilities on firm performance of the firms (H_7) were found significant. The qualitative data substantiate the above findings providing further insights into the hypothesis (H_2) that was not supported and those were supported (H_1,

H_3, H_4, H_5, H_6 and H_7). The findings also corroborate with the findings of related research reported in the extant literature.

Chapter 8: Conclusion

8.1. Introduction

This study mainly examined the antecedents and consequences of DCs and entrepreneurial capabilities of high-tech SMEs. Following the hypotheses formulated based on the empirical and conceptual evidence found in the extant literature, the study statistically tested seven hypotheses where the findings of the quantitative analysis were further explored using qualitative data that provided valuable insights into the nature of DCs and the relationships among the key constructs. Thus, this chapter presents the conclusion of the study drawn from the findings of the analysis of empirical data. The chapter is structured into six sections the present a summary of the main findings, the theoretical implications, the methodological implications, the managerial implications, the limitations of the study and directions for future research.

8.2. Summary of the Main Findings of the Study

This study addressed the research problem 'How do high-tech SMEs develop and apply DCs and entrepreneurial capabilities to improve firm performance?' The problem was further elaborated into three main research objectives: (1) To understand how firms develop and apply DCs - (a) testing the effect of the success trap on the development and application of DCs of high-tech SMEs and (b) testing the effect of market dynamism on the development and application of firms' DCs, (2) To examine the nature of DCs and their effect on entrepreneurial capabilities, i.e. exploratory capabilities and exploitative capabilities, and to test the relationship between exploratory capabilities and exploitative capabilities, and (3) To establish the effects of entrepreneurial capabilities on firm performance.Thus, the main findings of the study are summarised under each objective above.

In addressing the effect of the success trap on the development and application of DCs of high-tech SMEs, as a part of the first objective of the study, it was found that the success trap has a significant negative effect on DCs of the firms. As it was shown by the descriptive statistics, the firms have fallen into the success trap to a moderately short extent. The qualitative data indicate that the naturally high-tech nature of the firms and their strategic management of resources have protected them from getting caught in the success trap.

In addressing the effect of market dynamism on the development and application of DCs of high-tech SMEs, which is also a part of the first objective of the study, the results of the hierarchical regression analysis revealed that market dynamism is not a significant predictor of DCs. The qualitative data explained the unique nature of the customers, technologies, and competition in the market environments the firms are operating could be partly responsible for the above insignificant effect of market dynamism on the development and application of DCs.

The second objective of the study was to examine the nature of DCs and their effect on entrepreneurial capabilities, i.e. exploratory capabilities and exploitative capabilities, and to test the relationship between exploratory capabilities and exploitative capabilities of the high-tech SMEs. The statistical analysis resulted in two distinctive components of DCs: absorptive capability and transformative capability (Garud and Nayyar, 1994; Pandza and Holt, 2007) explaining how firms develop DCs by acquiring external knowledge and assimilating in to the existing knowledge and how firms transform such knowledge by adapting existing products, processes, and systems and by innovating new products, processes, and systems. The qualitative data reveal practices with regard to absorptive capability and transformative capability that are common across the high-tech SMEs.

As far as the effect of DCs on entrepreneurial capabilities of exploratory capabilities and exploitative capabilities in high-tech SMEs is concerned, the hierarchical regression analysis reports that DCs have significant positive effects on exploratory capabilities and exploitative capabilities of high-tech SMEs. This confirms Teece's (2007) claim that those enterprises with DCs are 'intensely entrepreneurial'. As it came to light in the interviews, the firms more or less maintain a balance between exploration and exploitation and depending on the stage of their business, firms may focus more on either exploration or exploitation. The correlation analysis reports that exploratory capabilities and exploitative capabilities have significant positive correlation with each other confirming the proposed co-evolutionary relationship between the two types of entrepreneurial capabilities. Moreover, the firms tend to adopt contextual ambidexterity rather than structural ambidexterity due to resource limitations.

The third objective was to establish the effect of entrepreneurial capabilities on firm performance of high-tech SMEs. The statistical analysis indicates that both exploratory

capabilities and exploitative capabilities have significant positive effects on firm performance of high-tech SMEs. The qualitative data also indicate this positive relationship where firms have been developing radically innovative technologies using their exploratory capabilities and have also been exploiting existing products and technologies using their exploitative capabilities that help improve their performance.

8.3. Theoretical Implications of the Study

The study makes a significant contribution to the strategic management literature by extending the knowledge on DCs and entrepreneurial capabilities.

Dynamic Capabilities

This study reports that the antecedents of DCs can be identified as internal as well as external. As far as the proposed internal antecedent the success trap is concerned, it was found that the success trap has a significant negative effect on DCs. For the first time in the DCs literature, the study empirically tested the effect of the success trap (Ahuja and Lampert, 2001; Levinthal and March, 1993) on the development and application of DCs.

The popular external antecedent market dynamism (e.g. Cui, Griffith and Cavusgil, 2005; Lavie, 2006; Tripsas, 1997; Volberda, 1996; Zahra, Sapienza and Davidson, 2006) was not found to have a significant effect on DCs of firms. As suggested by the qualitative findings, this could be due to the nature of the business of high-tech SMEs. Thus, the study concludes that the effect of market dynamism on DCs can be context specific. These findings are particularly important as the role of the environmental dynamism or market dynamism has been central to the debate on Teece, Pisano and Schuen's (1997) original definition of DCs.

With regard to the development and application of DCs, the study clearly indicates that DCs have commonalities across firms (Eisenhardt and Martin, 2000) and indentifies two conceptually distinct but complementary components of the construct of DCs: absorptive capability and transformative capability (Garud and Nayyar, 1994; Pandza and Holts, 2007). As mentioned above, these findings show how firm develop DCs by acquiring external knowledge and assimilating in to the existing knowledge and how firms transform such knowledge by adapting existing products, processes and systems and by innovating new products, processes and systems. Furthermore, the findings

validate Wang and Ahmed's (2007) original classification of DCs, i.e. adaptive capability, absorptive capability, and innovative capability, by incorporating the outward-looking capabilities into the component absorptive capability and inward-looking capabilities of adaptive and innovative capabilities into the component transformative capability. The study also identified the firm-specific routines of DCs within those commonalities in light of the qualitative findings.

Entrepreneurial Capabilities

The study makes a significant contribution to the entrepreneurship literature by empirically testing the key constructs of exploratory capabilities and exploitative capabilities as core firm-level entrepreneurial capabilities (Alvarez and Busenitz, 2001; Shane and Venkataraman, 2000) in the context of high-tech SMEs. The positive and significant effect of DCs on exploratory capabilities and exploitative capabilities are reported. The study confirms how exploratory capabilities and exploitative capabilities can equally and significantly contribute to firm performance (He and Wong, 2004). Furthermore, as suggested in the literature (e.g. He and Wong, 2004), exploratory capabilities and exploitative capabilities were measured with reference to a firm itself and its existing capabilities, resources and processes, and not relating to a competitor or at the industry level. The findings also suggest that the complementary relationship between exploratory and exploitative capabilities highlight the importance of firms becoming ambidextrous (O'Reilly and Tushman, 1996). These findings also explain how firms could achieve differential performance depending on the level of their DCs and in turn entrepreneurial capabilities.

8.4. Methodological Implications of the Study

Methodologically the study contributes to the strategic management literature by developing measures for two important constructs: DCs and the success trap. Prior research on DCs and the success trap is largely conceptual, and empirical work is piecemeal in nature due to the lack of effective measures. Going beyond anecdotal evidence of DCs and the success trap research, the new measures may be adopted by future researchers to measure firm-level DCs and the success trap to increase the comparability and generalisability of research findings. The study developed measures for DCs by adapting existing measures in the literature (Gibson and Birkinshaw, 2004; Garcia-Morales et al., 2008; Hughes and Morgan, 2007; Wang and Ahmed, 2004). The study also developed original measures for the success trap construct based on

Levinthal and March's (1993) conceptualisation and Ahuja and Lampert's (2001) clarification of the key essence of the success trap. Adapting those measures, more comprehensive measures can be developed by future researchers.

8.5. Managerial Implications of the Study

This study has several important implications for managers of high-tech SMEs. First, the managers should remember that in the context of high-tech industries, as it was indicated by the findings of the study, responding to market is necessary but not a sufficient condition in staying ahead of the competition. The study indicates that the firms need to have systematic processes and systems to acquire and assimilate external knowledge and technologies and more importantly to develop new technologies by adapting and innovating based on such knowledge and technologies.

Second, the high-tech SMEs carry the risk of falling into the success trap as they are heavily focusing on niche markets and sticking to existing technologies due to reasons such as resource constraints, comfort, customer-focus, difficulty in getting to the market, wrong perception of the business, inability to understand the market needs, reluctance to take the risk etc. Particularly, as it has been pointed out by Liao, Welsch and Stoica (2003), the limited financial resources and risk-bearing capability may lead SMEs to the success trap. Thus, managers should focus on acquiring new resources through networking and other effective strategies to avoid the success trap that could hamper development and use of DCs.

Third, understanding commonalities of DCs across firms and how firms can develop unique, firm specific DCs within those commonalities is important for managers of firms in gaining and sustaining the competitive advantage. It is particularly important to clearly distinguish between absorptive capability and transformative capability of high-tech SMEs. Pandza and Holt (2007) claim that smaller technology-driven firms with established identity based on their expertise in aspects of an emergent technology need less absorptive capability and more transformative capability.

8.6. Limitations of the Study and Directions for Future Research

This study is not free from limitations. First, the measurements of constructs may not have captured all of the dimensions of the constructs. They need to be refined employing methods such as confirmatory factor analysis.

Second, the study may have suffered from the limitations of mail survey method such as receiving incomplete responses, limited choice over the length of the questionnaire, respondents misunderstanding and misinterpretation of questions (Bryman and Bell, 2003; Hoinville and Jowell, 1978; Jenkins and Dillman, 1997; Neuman, 2003). Therefore, it is encouraged to do follow-up surveys and use alternative methods such as on-line surveys to cross validate the data.

Third, a considerable number of questionnaires were not delivered due to inaccurate details of firms found on the database used. Therefore, the small sample size of the survey could be another limitation in generalising the findings of the study. This may be avoided by drawing the sample from a more reliable and comprehensive source.

Fourth, as far as the interview method is concerned, use of semi-structured interviews, the short duration of interviews, using a single interviewee from each firm, interviews predominantly being telephone interviews, and the limited number of interviews may have reduced the richness of the interview data. Conducting unstructured, exploratory interviews in developing the research models and using semi-structured interviews that are of adequately long duration and also conducting interviews with multiple informants from each firm are encouraged.

Fifth, limited number of effective responses to the survey and time constraints forced to apply the data analysis methods used in the study. Accordingly, in addition to the use of confirmatory factor analysis in developing new measurements for the constructs as mentioned above, it is suggested that future researchers employ methods such as structural equation modelling to test the whole research model.

In addition, it is recommended that future research focus on several areas. First, it may be useful to empirically examine the effect of other possible external and internal antecedents of dynamic capabilities. As discussed in the literature (e.g. Danneels, 2010), it is worth examining the role of the top managers of firms and the effect of change in the economic conditions on developing and exercising on DCs and entrepreneurial capabilities. That will open up avenues for identifying strategies to get the maximum out of the managers and to avoid the negative effects of adverse economic conditions on firm performance. In addition, following Lavie, Stettner and Tushman (2010), it is also recommended that future research consider both short-term and long-term performance

effects of exploratory and exploitative capabilities and also the effects of factors such as managerial inclination and environmental dynamism on exploratory and exploitative capabilities and firm performance relationship. Therefore, following Easterby-Smith, Lyles and Peteraf (2009), it is recommended that a longitudinal study design that employs multiple methods at different points of time over a reasonable period would be better in studying constructs such DCs and entrepreneurial capabilities and their effects on firm performance.

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Appendix 1: SIC Codes Conversion Table

Aerospace			
SIC03		***SIC07***	
3530	Manufacture of aircraft & spacecraft	30300	Manufacture of air and spacecraft and related machinery
Pharmaceuticals			
SIC03		***SIC07***	
2441	Manufacture of basic pharmaceutical prods	21100	Manufacture of basic pharmaceutical products
2442	Manufacture of pharmaceutical preparations	21200	Manufacture of pharmaceutical preparations
		72110	Research and experimental development on biotechnology
Office and Computing			
SIC03		***SIC07***	
3210	Manufacture of electronic components	26110	Manufacture of electronic components
		26120	Manufacture of loaded electronic boards
3002	Manufacture computers & process equipment	26200	Manufacture of computers and peripheral equipment
		62011	Ready-made interactive leisure and entertainment software development
		62012	Business and domestic software development
			Computer consultancy activities
		62030	Computer facilities management activities
			Other information technology and computer service activities
7230	Data processing	63110	Data processing, hosting and related activities
7240	Data base activities	63110	Data processing, hosting and related activities
		63120	Web portals
Radio, TV and Communication Equipment			
SIC03		***SIC07***	
3162	Manufacture other electrical equipment	26301	Manufacture of telegraph and telephone apparatus and equipment
		26309	Manufacture of communication equipment other than telegraph, and telephone apparatus and equipment
		61100	Wired telecommunications activities
		61200	Wireless telecommunications activities
		61900	Other telecommunications activities
Medical and Optical Equipments			
SIC03		***SIC07***	
3310	Manufacture medical, orthopaedic etc. equipment	32500	Manufacture of medical and dental instruments and supplies
3340	Manufacture optical, photographic etc. equipment		

Source: http://www.companieshouse.gov.uk/infoAndGuide/sic/sicConversionTable.shtml

Appendix 2: A Summary of Measures and Indicators of the Key Constructs

1. The Success Trap

Author/s and the Year	Equivalent Construct	Dimensions/Definitions	Original Measures	Research Context	Others Who Used This Work
Levitt and March (1988)	Competency trap	A *competency trap* can occur when favourable performance with an inferior procedure leads an organization to accumulate more experience with it, thus keeping experience with a superior procedure inadequate to make it rewarding to use (1988:322).		A conceptual paper	
Leonardo-Barton (1992)	Core rigidities	*Core rigidities*: Inappropriate sets of knowledge (1992:118).		A conceptual paper	
Levinthal and March (1993)	Learning traps	*The failure trap*- Failure leads to search and change which leads to failure which leads to more search, and so on. New ideas and technologies fail and are replaced by other new ideas and technologies, which fail in turn (1993:105-106). *The success trap*- As they [firms] develop greater and greater competence at a particular activity, they [firms] engage in that activity more, thus furthers increasing competence and the opportunity cost of exploration (1993:106).		A conceptual paper	
Ahuja and Lampert (2001)	Organisational pathologies	*The familiarity trap* - a tendency to favour the familiar over the unfamiliar (2001:531). • Firm works in a single technology, not exploring any others. However, in that single technology it usually works on the leading edge and often uses a very original approach in terms of addressing the problems in that technology (2001:531). *The maturity trap* - a tendency to prefer the mature over the nascent (2001:531). • Firm explores several technologies but usually works on mature technologies. Within these mature technologies it sometimes adopts a very original approach to addressing the problems in that technology. *The propinquity trap* - a tendency to search for solutions that are near to existing solutions rather than search for completely new solutions (2001:531). • Firm explores several technologies but usually works on leading-edge technologies. Within these leading-edge technologies it usually adopts an unoriginal approach, preferring to work on problems and solutions that have well established precedents.		An empirical study in the global chemicals industry	

2. Market Dynamism

Author/s and the Year	Equivalent Construct	Dimensions/Definitions	Original Measures	Research Context	Others Who Used This Work
Jaworski and Kohli (1993)	Environmental context of organizations	*Market turbulence*: The rate of change in the composition of customers and their preferences' (1993:57).	1. In our kind of business, customers' product preferences change quite a bit over time. 2. Our customers tend to look for new product all the time. 3. Sometimes our customers are very price-sensitive, but on other occasions, price is relatively unimportant.* 4. We are witnessing demand for our products and services from customers who never bought them before. 5. New customers tend to have product-related needs that are different from those of our existing customers. 6. We cater to many of the same customers that we used to in the past. (Reliability of scales α=.68) (5-point Likert scale from 1 = "strongly disagree" to5 = "strongly agree") *This item was eliminated by Jaworski and Kohli (1993), based on the scale refinement procedure.	An empirical study among a sample of US firms on their market orientation	Cui, Griffith and Cavusgil (2005) (α= .90).;Rose and Shoham (2002); Jansen, Van den Bosch and Volberda (2005b) (α=.85); Auh and Menguc (2005); Srinivasan, Lilien and Rangaswamy (2002) ; Zhou (2006); Megicks and Warnaby (2008)
		Competitive intensity: The level of competition in the market (Jaworski and Kohli (1993).	1. Competition in our industry is cutthroat. 2. There are many "promotion wars" in our industry. 3. Anything that one competitor can offer, others can match readily. 4. Price competition is a hallmark of our industry. 5. One hears of a new competitive move almost every day. 6. Our competitors are relatively weak. (Reliability of scales α=.81) (5-point Likert scale from 1 = "strongly disagree" to 5 = "strongly agree")		Cui, Griffith and Cavusgil (2005) (α= .90); Rose and Shoham(2002) (α=.77); Jansen, Van den Bosch and Volberda (2005b)(α=.85); Zhou (2006)(α=.78); Megicks and Warnaby(2008)(Reliability was close to 0.70); Auh and Menguc (2005);Zhou(2006)
		Technological turbulence: The rate of technological change (1993:57).	1. The technology in our industry is changing rapidly. 2. Technological changes provide big opportunities in our industry. 3. It is very difficult to forecast where the technology in our industry will be in the next 2 to 3 years.* 4. A large number of new product ideas have been made possible through technological breakthroughs in our industry. 5. Technological developments in our industry are rather minor. (Reliability of scales α=.88) (5-point Likert scale from 1 = "strongly disagree" to 5 = "strongly agree") *This item was eliminated by Jaworski and Kohli (1993), based on the scale refinement procedure.		Rose and Shoham (2002) (α=.84); Zhou (2006) (α=.88)
Miller (1987)	Environmental dynamism	Dynamism in the environment is manifested by the amount and unpredictability of change in customer tastes, production or service technologies, and modes of competition in the firm's principal industries (1987:74).	Changes in firm's external environment over the past 5 years. *Dynamism:* Over the past 5 years, 1. Growth opportunities in the environment: Have decreased dramatically — 12 3 4 5 6 7 — Have increased dramatically No change 2. Production/service technology in your principal industry: Has changed very much — 1 2 3 4 5 6 7 — Has remained the same No change 3. Rate of innovation of new operating processes and new products or services in your principal industry: Rate has fallen dramatically — 12 3 4 5 6 7 — Rate has dramatically increased No change 4. Research and development (R&D) activity in your principal industry: Has substantially increased — 12 3 4 5 6 7 — Has fallen off greatly No change * For ease of interpretation all inverted scales were reversed in the analyses to have a score of 1 reflect a decrease or no change in the variable and 7 an increase (Miller, 1987:73). (Reliability of scales is not given in Miller (1987)	An empirical study of 161 US firms and 110 Canadian and Australian firms	Han, Kim and Srivastava (1998)

Miller and Friesen (1982)	Environmental dynamism		1. Our firm must rarely change its marketing practices to keep up with the market and competitors -1-2-3-4-5-6-7- Our firm must change its marketing practices extremely frequently (e.g. semi- annually). 2. The rate at which products services are getting obsolete in the industry is very slow(e.g. basic metal like copper) -1-2-3-4-5-6-7- The rate of obsolescence is very high (as in some fashion goods and semi-conductors). 3. Actions of competitors are quite easy to predict(as in some primary industries) -1-2-3-4-5-6-7- Actions of competitors are unpredictable. 4. Demands and consumer tastes are fairly easy to forecast (e.g. for milk companies) -1-2-3-4-5-6-7- Demand and tastes are almost unpredictable (e.g. high fashion goods). 5. The production/service technology is not subject to very much change and is well established(e.g. in steel production) -1-2-3-4-5-6-7- The modes of production/service change often and in a major way (e.g. advanced electronic companies). (Reliability of scales is not given)	An empirical study among a sample of Canadian firms across retailing, furniture manufacturing,broadcasting, pulp and paper, food, plastics,electronics,chemicals, meatpacking, publishing, construction and transportation industries	Miller (1983) (α = 0.74); Naman and Slevin (1993) (α = 0.629);Lumpkinand Dess(2001)
Miller and Friesen (1983)	Environmental dynamism	Environmental dynamism is 'the rate of change and innovation in the industry as well as the uncertainty or unpredictability of the actions of competitors and customers' (1983:222).	Changes in the firm's external environment over the past 5 years 1. Market activities of your key competitors: Have become far more predictable — 12 3 4 5 6 7 — Have become far less predictable No change 2. The tastes and preferences of your customers in your principal industry: Have become much more stable and predictable — 12 3 4 5 6 7 — Have become much more hard to forecast. No change 3. Rate of innovation of new operating processes and new products or services in your principle industry: Rate has fallen dramatically — 12 3 4 5 6 7 — Rate has dramatically increased No change 4. Your principal industry's downswings and upswings: Have become far more predictable — 12 3 4 5 6 7 — Have become far less predictable No change 5. Market activities of your key competitors: Have become far more hostile — 12 3 4 5 6 7 — Have become far less hostile No change 6. Market activities of your key competitors: Now affect the firm in far fewer areas — 12 3 4 5 6 7 — Now affect the firm in many more areas (e.g. pricing, delivery, service, quality, etc.) No change 7. Needed diversity in your production methods and marketing tactics to cater to your different customers: Diversity has dramatically decreased — 12 3 4 5 6 7 — Diversity has dramatically increased No change (Reliability of scales is not given)	An empirical study among a sample of Canadian firms across 15 industries and based on published data a sample of US firms	

Jap (1999)	Environmental dynamism		1. The environmental demands on us are constantly changing. 2. Marketing practices in our industry are constantly changing. (The reliability of scales for the above items is not given). (7-point Likert scales 1="strongly dis- agree; 7 = "strongly agree")	An empirical study among a sample of procurement divisions of four Fortune 50 manufacturing companies	Cui, Griffith and Cavusgil (2005)
Eisenhardt and Martin (2000)	Dynamic markets	*Moderately dynamic markets* are characterised by stable industry structure, defined boundaries, clear business models, identifiable players, and linear and predictable change. *High-velocity markets* are characterised by ambiguous industry structure, blurred boundaries, fluid business models, ambiguous and shifting players, and non-linear and unpredictable change.		A conceptual paper	
Cui, Griffith and Cavusgil (2005)	Market dynamism: Market dynamism refers to the degree of change in the market. Market dynamism includes changes of various market elements, such as customer demand, technology, and competitor structure (2005:37).	The two dimensions of market dynamism: the extent to which 1. the environmental demands on the firm are constantly changing and 2. the business practices in the industry are constantly changing (2005:41).		An empirical study among a sample of FDIs of MNC in Croatia	
Baker and Sinkula (2005)	Market turbulence	We view market turbulence as a composite of (1) change in production/service technology, (2) competitive intensity, and (3) the general rate of change in an industry (2005:465).	1. The extent to which the production/service technology in your principal market has changed during the past 3 years. 2. The level of competitive intensity in your principle served market segment. 3. In general, the rate of change in the market place in principle served market segment. (Reliability of scales α=.62) (7-point Likert scales anchored *low-high*)	An empirical study among a sample of 243 firms in the US	
Atuahene-Gima (2005)	Environmental turbulence [Market dynamism]	Environmental turbulence reflects rapid market and technological changes that managers perceive as hostile and stressful conditions for their firm (2005:66).	Indicate your degree of agreement about how well these statements describe the market and competitive environment during the last three years. 1. The actions of local and foreign competitors in our major markets were changing quite rapidly. 2. Technological changes in our industry were rapid and unpredictable. 3. The market competitive conditions were highly unpredictable. 4. Customers' product preferences changed quite rapidly. 5. Changes in customers' needs were quite unpredictable. (Interrater reliability r = .95) (5-point Likert scales from1= "strongly disagree" to 5= "strongly agree")	An empirical study of 127 electronics firms in China	
Davis, Eisenhardt and Bingham (2007)	Market dynamism	*Velocity* Pace of opportunity flow into the environment (2007:46). *Complexity* Degree to which the environment has many interrelated features and contingencies (2007:46). *Ambiguity* Degree to which the environment is difficult to interpret or understand (2007:46). *Unpredictability* Degree to which it is difficult to forecast the environment and predict the nature of future opportunities (2007:46).	*Measure of Velocity* Rate, λ, of opportunities flowing into environment per time, t, in a Poisson process *Measure of Complexity* Number of correct actions (both rule-based and improvised) needed to capture an opportunity *Measure of Ambiguity* Proportion of *perceived features* that differ from *actual features* in an opportunity *Unpredictability* Entropy distribution (measuring disorder) over probability, p, of opportunity features being either 1 or 0. (The reliability of scales for the above items is not given).	A simulation study	

3. Dynamic Capabilities

3.1. Adaptive Capability

Author/s and the Year	Equivalent Construct	Dimensions/Definitions	Original Measures	Research Context	Others Who Used This Work
Chakravarthy (1982)	Adaptive ability: The state of adaptation that a firm aspires and this depends on the firm's resources (1982:37).	• *Organizational capacity* (the firm's ability to process information) • *Material capacity* (material inputs, finance, and technology)		A conceptual paper	
Oktemgil and Greenlay (1996)	Adaptive capability: The ability to identify and capitalize on emerging market opportunities (1996:445).	• Response to product-market opportunities • Marketing activities for responding to these opportunities • Speed of response in pursuing these opportunities	1. Product-market response: This activity was measured as product/service opportunities, and the complexity of the markets in which they are positioned. *Product service opportunities:* *New product/service success rate* (from 1 = "not successful" to 7 = "very successful"). *Product/service modification success rate* (from 1 = "not successful" to 7 = "very successful"). *Product/service obsolescence rate* (from 1 = "very slow" to 7 = "very quick"). *Market Complexity:* The following aspects of complexity were measured on a scale from 1 = "not complex" to 7 = "very complex": -Customer buying behaviour. -Competitive rivalry. -Production. 2. Marketing activities for responding to these opportunities. The respondents were asked to give the extent of their agreement with the following statements, using a scale from 1 = "disagree" to 7 = "fully agree": - We regularly monitor changes in our markets. - We frequently adopt new marketing techniques. - We continuously monitor competitors' actions. - We allocate a substantial part of our resources to marketing practices. -We give close attention to after-sales service. 3. Speed of response in pursuing these opportunities. This activity was measured with respect to key elements of the marketing mix, as they are immediate actions that must be taken to adapt to market change. The respondents were asked to state how quickly they modify the following elements, using a scale where 1 is very slowly and is once a year, through to 7 is very quickly and monthly: -Product/service modifications. -Pricing changes. -Advertising campaigns. -Selling programmes. -Distribution schedules.	An empirical study of 408 firms in the UK machine-tools industry.	
Gibson and Brikinshaw (2004)	*Adaptability*: The capacity to reconfigure activities in the business unit quickly to meet changing demands in the task environment (2004:209).		1. The management systems in this organization encourage people to challenge outmoded traditions/practices/sacred cows. (α=.79) 2. The management systems in this organization are flexible enough to allow us to respond quickly to changes in our markets. (α=.92) 3. The management systems in this organization evolve rapidly in response to shifts in our business priorities. (α=.90). (Overall reliability of scales α=.80). (7-point Likert scale)	An empirical study of a sample of 4,195 individuals from 41 business units in ten multinational firms in different industries from Japan,USA,Canada,India,France, and South Korea.	Zhou and Li (2010) developed and used a scaled based on Gibson and Brikinshaw (2004).The composite reliability = 0.78.

3.2. *Absorptive Capability*

Author/s and the Year	Equivalent Construct	Dimensions/Definitions	Original Measures	Research Context	Others Who Used This Work
Cohen and Levinthal (1990)	*Absorptive capacity:* The ability of a firm to recognize the value of new information, assimilate it, and apply to commercial ends (1990:128).		• R&D intensity of a firm (R & D investment/Sales).	A study in the American manufacturing sector.	Lane and Lubtakin (1998); Tsai (2001); Stock (2001).
Liu and White (1997)	*Absorptive capacity*		• Investment in R&D personnel.	A study of Chinese manufacturing industries	
Szulanski (1996)	Absorptive capacity: Ability of the recipient unit to identify value and apply new knowledge (1996:34).		• Members of <recipient> have a common language to deal with the <practice>; • <recipient> had a vision of what it was trying to achieve through the transfer; • <recipient> had information on the state-of-the-art of the <practice>; • <recipient> had a clear division of roles and responsibilities to implement the <practice>; • < recipient> had the necessary skills to implement the <practice>; • <recipient> had the technical competence to absorb the <practice>; • <recipient> had the managerial competence to absorb the <practice>; • It is well known who can best exploit new information about the <practice> within <recipient>; • It is well known who can help solve problems associated with the <practice>. (Practice = different practices of the firm) (Recipient = different departments of the firm) (A single balanced 5- point Likert-type scale that was used: Y! = "Yes!"; Y = "Yes, but"; o = "No opinion"; N = "No, not really"; N! = "No!") (Cronbach α= 0.83)	A study based on 271 observations of 122 best-practice transfers in eight companies (AMP, AT&T Paradyne, British Petroleum, Burmah Castrol, Chevron Corporation, EDS, Kaiser Permanente, and Rank Xerox)	
George et al (2001)			• R&D spending • The number of patents	A study of US biotechnology firms.	
Deeds (2001)			• Co-citation analysis	A study of US pharmaceutical biotechnology companies.	
Zahra and George (2002)	Absorptive capacity: A set of organizational routines and processes by which firms acquire, assimilate, transform, and exploit knowledge to produce dynamic organizational capability (2002:185).	• *Knowledge acquisition* • *Knowledge assimilation* • *Knowledge transformation* • *Knowledge exploitation*	Measures suggested by Zahra and George (2002) *Knowledge acquisition*: -Years of experience of the R&D department. - Amount of R & D investment. *Knowledge assimilation*: - The number of cross-firm patent citations or number of citations made in a firm's publications to research developed in other firms. *Knowledge transformation:* - Number of new product ideas and research projects (2002:199). *Knowledge exploitation*: - The number of patents, new product announcements, length of product development cycle.	A conceptual paper	Branzei and Vertinsky (2006) used Zahra and George's (2002) dimensions to develop a measure for product innovation capabilities.
Liao, Welsch and Stoica (2003)		Absorptive capacity was measured along two dimensions: *-External knowledge acquisition*: The capability through which environmental signals are identified and information embedded in those signals is gathered and transmitted back to the organization (2003:72). *-Internal knowledge dissemination*: A firm's capacity to disseminate and share knowledge (2003:72).	The measure is not available.	An empirical study among a sample of SMEs in the USA.	

Jansen, Van den Bosch and Volberda (2005a)			POTENTIAL ABSORPTIVE CAPACITY: *Acquisition* Our unit has frequent interactions with corporate headquarters to acquire new knowledge. Employees of our unit regularly visit other branches. We collect industry information through informal means (e.g. lunch with industry friends, talks with trade partners). Other divisions of our company are hardly visited.(reverse-coded) Our unit periodically organizes special meetings with customers or third parties to acquire new knowledge. Employees regularly approach third parties such as accountants, consultants, or tax consultants. *Assimilation* We are slow to recognize shifts in our market (e.g., competition, regulation, demography). (reverse-coded) New opportunities to serve our clients are quickly understood. We quickly analyze and interpret changing market demands. REALIZED ABSORPTIVE CAPACITY: *Transformation* Our unit regularly considers the consequences of changing market demands in terms of new products and services. Employees record and store newly acquired knowledge for future reference. Our unit quickly recognizes the usefulness of new external knowledge to existing knowledge. Employees hardly share practical experiences. (reverse-coded) We laboriously grasp the opportunities for our unit from new external knowledge. (reverse-coded) Our unit periodically meets to discuss consequences of market trends and new product development. *Exploitation* It is clearly known how activities within our unit should be performed. Client complaints fall on deaf ears in our unit.(reverse-coded) Our unit has a clear division of roles and responsibilities. We constantly consider how to better exploit knowledge. Our unit has difficulty implementing new products and services.(reverse-coded) Employees have a common language regarding our products and services.	An empirical study conducted at a large, European, multi-unit financial services firm	
Narasimhan, Rajiv and Dutta (2006)	Absorptive capacity: The efficiency with which a firm absorbs, relative to what it could have absorbed given the resources it has deployed (2006:512)	The conceptualization of absorptive capacity consists of two components of: *first*, the resources that a firm has at its disposal to achieve its goal of absorbing know-how (which explain how much it could absorb), and *second*, the reasons for a firm's differential abilities to absorb technological know-how from outside	Maximum Know-How Absorbable=*f* (R&D expenditure_ Marketing Expenditure, Innovation Stock)	A study of a sample of firms in the semiconductor and computer industries in the USA.	

Wang et al.(2007)			*Absorptive capacity* 1. The adopting firm had information on the state-of-art of the ERP system. 2. The adopting firm had a clear division of roles and responsibilities to implement the ERP system. 3. The adopting firm had the needed skills to learn and understand the ERP system. 4. The adopting firm had the technical competence to absorb the ERP system. 5. The adopting firm had the managerial competence to absorb the ERP system. (Reliability = 0 .91) (5-point Likert scale, anchored from 1 = "strongly disagree" to 5 = "strongly agree")		
Tu et al.(2006)	*Absorptive capacity*: Organizational mechanisms to identify, communicate, and assimilate relevant external and internal knowledge (2006:695).		*Worker knowledge (WK)* - The general knowledge level of our first-line workers is high. - The overall technical knowledge of our first-line workers is high. - The general educational level of our first-line workers is high. - The overall job competence of our first-line workers is high. (α= 0.87) *Manager knowledge (MK)* - The knowledge of our managers is adequate when making business decisions. - The knowledge of our managers is adequate when dealing with new technologies. - The knowledge of our managers is adequate when managing daily operations. - The knowledge of our managers is adequate when solving technical problems. (α= 0.84) *Communications network (CN)* - The communications between supervisors and their subordinates are extensive. - The communications among functional areas are extensive. - The communications among functional areas are frequent. - The communications between supervisors and their subordinates are frequent. - The communication of new ideas from one department to another is extensive. (α= 0.86) *Communications climate (CC)* - Our employees tend to trust each other. - Our employees are supportive of each other. - Our employees have strong feelings of belonging to our organization. - Our employees share ideas freely with each other. - Our employees have no difficulty accepting new ideas. - Our employees are willing to accept changes. (α= 0.87) *Knowledge scanning (KS)* - We seek to learn from tracking new market trends in our industry. - We seek to learn from routine search of useful information. - We seek to learn from benchmarking best practices in our industry. - We seek to learn from trying out new technologies. - We seek to learn from our customers and suppliers. - We seek to learn from taking new business opportunities. - We seek to learn from conducting R&D activities. (Reliability α= 0.80) (Tu et al., 2006:701)	A study of a sample of manufacturing SMEs in the US.	

Vega-Jurado (2008)			The following questions were used to build our measures of PACAP and RACAP*. 1. PACAP. Please indicate which of the following mechanisms are usually used as sources of knowledge by your enterprise? - Subscriptions to journals - Attendance at conferences and congress - Attendance at scientific fairs or exhibitions 2. RACAP. Please indicate if the following agents have been an important source of knowledge to develop any of innovations introduced by your firm during the period 2001–2003. - Suppliers - Consumers - Universities - Technology institutes *Potential absorptive capacity (PACAP) (knowledge acquisition and assimilation) and realized absorptive capacity (RACAP) (transformation and exploitation of knowledge).	Study among small and medium-sized enterprises located on two industrial estates in the province of Valencia (Spain).	
Fosfuri and Tribó (2008)			*PAC**: Please indicate the importance (from 1 to 4) for your innovation activity of the following external sources of information during the period 1998–2000: 1. suppliers, 2. customers, 3. competitors, 4. universities, 5. public research institutions and technology parks, 6. conferences, meetings and specialized journals, 7. exhibitions and showrooms. *PAC- Potential absorptive capacity	Study among a sample of 2464 innovative Spanish firms	
García-Morales, Llorens-Montes and Verdu –Jover (2008)			1. The organization has a clear division of roles and responsibilities for acquiring new knowledge. 2. The organization has the necessary skills to implement new acquired knowledge. 3. The organization has the competences to transform the new acquired knowledge. 4. The organization has the competences to use the new acquired knowledge. (Reliability of scales α=.850). (7-point Likert-scale)	An empirical study among a sample of 900 organisations in Spain.	

3.3. *Innovative Capability*

Author/s and the Year	Equivalent Construct	Dimensions/Definitions	Original Measures	Research Context	Others Who Have Used This Work
Schumepeter (1934)	*Innovation*: The commercial or industrial application of something new.	• Ability to develop a new product or process • Ability to develop a new form of organization • Ability to develop a new source of supply or market		A conceptual work.	
Miller and Friesen (1983)	*Innovation*: includes introductions of new products and production-service technologies, the search for novel solutions to marketing and production problems, the attempt to lead rather than to follow competitors (proactiveness), and risk-taking (1983:222)		• The rate, relative to competitors of new product/service introduction by the firm: Has decreased very much — 1 2 3 4 5 6 7 — No change — Has increased very much • The rate of change in your methods of production or rendering of services: Rate of change has declined much — 1 2 3 4 5 6 7 — No change — Change has accelerated rapidly • Risk taking by key executives of the firm in seizing and exploring 'chancy growth opportunities: Has decreased very much — 1 2 3 4 5 6 7 — No change — Has increased very much • In dealing with its competitors, the firm: Resorts much more to a live and let live philosophy — 1 2 3 4 5 6 7 — No change — Has become more aggressive • Seeking of unusual, novel solutions by senior executives to problems via the use of 'idea men', 'brainstorming', etc.): Has become less common — 1 2 3 4 5 6 7 — No change — Has become much more common	An empirical study of a sample of Canadian firms and a sample of US firms.	Wang and Ahmed (2004)
Lawson and Samson (2001:384)	*Innovation capability:* The ability to continuously transform knowledge and ideas into new products, processes and systems for the benefit of the firm and its stakeholders.			A conceptual paper	
Hagedoorn and Duysters (2002:168)	*Innovative capability*: Innovative capability concerns the specific expertise and competence related to the development and introduction of new processes and products (2002:168).		Patent intensity (number of patents divided by a firm's turnover in its core business).	A study of a sample of US, Canadian and European companies in the technology related industries.	
Calantone, Cavusgil and Zaho (2002)			Firm innovativeness 1. Our company frequently tries out new ideas. 2. Our company seeks out new ways to do things. 3. Our company is creative in its methods of operation. 4. Our company is often the first to market with new products and services. 5. Innovation in our company is perceived as too risky and is resisted. 6. Our new product introduction has increased over the last 5 years. (Reliability α=.89) (7-point Likert-type scale, ranging from 1 = "strongly disagree" to 7 = "strongly agree").	A study among a range of US manufacturing and services industries, including chemicals, machinery, electronic, instruments, computer and data processing, engineering and management services.	Hughes and Morgan (2007) (Reliability α =0.81); Lin (2007) (Composite reliability =.77).

Wang and Ahmed (2004)	*Organizational innovativeness*: Capability of introducing new products to the market, or opening up new products to the market, opening up new markets, through combining strategic orientation with innovative behaviour and process(2004:304).	*Behavioural innovativeness*: Behavioural innovativeness is demonstrated through individuals, teams and management enables the formation of an innovative culture, the overall internal receptivity to new ideas and innovation (2004:305). *Product innovativeness*: The novelty and meaningfulness of new products introduced to the market at a timely fashion (2004:304). *Process innovativeness*: The introduction of new production methods, new management approaches, and new technology that can be used to improve production and management processes (2004:305). *Market innovativeness*: The newness of approaches that companies adopt to enter and exploit the targeted market (2004:305). *Strategic innovativeness*: An organization's ability to manage ambitious organizational objectives, and identify a mismatch of these ambitions and existing resources in order to stretch or leverage limited resources creatively (2004:306).	*Behavioural innovativeness* (Cronbach's Alpha = 0.87) • We get a lot of support from managers if we want to try new ways of doing things • In our company, we tolerate individuals who do things in a different way • We are willing to try new ways of doing things and seek unusual, novel solutions • We encourage people to think and behave in original and novel ways *Product innovativeness* (Cronbach's Alpha = 0.86) • In new product and service introductions, our company is often first-to-market • Our new products and services are often perceived as very novel by customers • In comparison with our competitors, our company has introduced more innovative • In comparison with our competitors, our company has a lower success rate in new products and services launch(R) *Process innovativeness* (Cronbach's Alpha = 0.69) • We are constantly improving our business processes • Our company changes production methods at a great speed in • comparison with our competitors • During the past five years, our company has developed many new management approaches • When we cannot solve a problem using conventional methods, we improvise on new Methods Market *Market innovativeness* (Cronbach's Alpha = 0.68) • Our recent new products and services are only minor changes from our previous products and services (R) • New products and services in our company often take us up against new competitors products and services during the past five years • In comparison with our competitors, our products' most recent marketing programme is revolutionary in the market • In new product and service introductions, our company is often at the cutting edge of technology *Strategic innovativeness* (Cronbach's Alpha = 0.63) • Our firm's R&D or product development resources are not adequate to handle the development need of new products and services (R) • Key executives of the firm are willing to take risks to seize and explore "chancy" growth opportunities • Senior executives constantly seek unusual, novel solutions to problems via the use of "idea men" • When we see new ways of doing things, we are last at adopting them (R) (7-point Likert scale from 1 = "strongly disagree to 7 = "strogly agree")	A study of a sample of firms in the UK.	Henneke and Lüthje (2007) Cronbach's Alpha = 0.70.
Subramaniam and Youndt (2005)	*Incremental innovative capability:* The capability to generate innovations that refine and reinforce existing products and services (2005:452). *Radical innovative capability:* The capability to generate innovations that significantly transform existing products and services (2005:452).		The following items had this stem and response scale: How would you rate your organization's c*apability* to generate the following types of innovations in the products/services you have introduced in the last five years? (1 = "weaker than competition"; 4 = "similar to competition"; 7 = "stronger than competition")." *Incremental Innovative Capability* • Innovations that reinforce your prevailing product/service lines. • Innovations that reinforce your existing expertise in prevailing products/services. • Innovations that reinforce how you currently compete. *Radical Innovative Capability* • Innovations that make your prevailing product/service lines obsolete. • Innovations that fundamentally change your prevailing products/services. • Innovations that make your existing expertise in prevailing products/services obsolete. (Cronbach's alpha coefficients for each of the innovative capability constructs were above the suggested value of .70.)	A study of a sample of public, single business unit organizations in the USA.	

Hughes and Morgan (2007)	***Innovativeness*** captures a bias toward embracing and supporting creativity and experimentation, technological leadership, novelty and R&D in the development of products, services and processes.		*Innovativeness (INNOV)* 1. We actively introduce improvements and innovations in our business. 2. Our business is creative in its methods of operation. 3. Our business seeks out new ways to do things. (Reliability α =0.81) (7-point Likert scale from 1 = "strongly disagree" to 7 = "strongly agree").	A study of a sample of 211 emerging young UK high-tech firms	
Quintana-Garcia and Benavides-Velasco (2008)	***Innovative competence*** *Exploratory innovative competence* represents the ability to perform extensive searches that result in novel methods or materials technologically distant from existing innovations (2008:498). *Exploitative innovative competence* is the ability which improves methods or materials (2008:498).		*Innovative competence:* Number of total patents granted by the firm in a year. 1. *Exploratory innovative competence:* Number of patents granted by the firm in a year that cite no other patents. 2. *Exploitative innovative competence:* Number of patents granted by the firm in a year that include one or more citations or self-citations.	A study among a sample of US dedicated biotechnology firms (DBFs)	
Akman and Yilmaz (2008)	***Innovative capability*** An important factor that facilitates an innovative organisational culture, characteristics of internal promoting activities and capabilities of understanding and responding appropriately to the external environment (2008:79).		*While innovation activities at your firm are carried out*; 1. Our firm has an organisational culture and a management comprehension that support and encourage innovation. 2. At our firm, knowledge from different resources is used for product development activities efficiently and rapidly. 3. Our firm is able to reflect changes at market conditions (such as changes from customer wants, competitors' products, etc.) to own products and processes as soon as possible. 4. Workers of our firm are supported and encouraged to participate in activities such as product development, innovation process improvement and to produce new ideas such topics. 5. New ideas that come from customers, suppliers, etc. are evaluated continuously and try to include into product development activities 6. Our firms could be adapt to environmental changes easily and in the short time by making suitable improvements and innovations at its products and processes. (5-point Likert scale from 1 = "certainly disagree" to 5 = "certainly agree") (Reliability coefficient α =0.86)	A study of a sample of 156 firms in the Turkish software industry	

4. Exploratory Capabilities

Author/s and The Year	Equivalent Construct	Dimensions/Definitions	Original Measures	Research Context	Others Who Used This Work
March (1991)	Exploration: Exploration includes things captured by terms such as search, variation, risk taking, experimentation, play, flexibility, discovery, innovation (1991:71).			A simulation study	
He and Wong (2004)	Exploration: Exploration implies firm behaviours characterized by search, discovery, experimentation, risk taking and innovation (2004:481).		Original measures developed by He and Wong (2004) to measure explorative innovation strategy. Objectives for undertaking innovation projects in the last 3 years (from 1 = "not important" to 5 = "very important") • Introduce new generation of products • Extend product range • Open up new markets • Enter new technology fields (Cronbach alpha 0.752)	Study of a sample of 206 manufacturing firms in Singapore and Penang, Malaysia	
	Exploitation: Exploitation implies firm behaviours characterized by refinement, implementation, efficiency, production and selection (2004:481).		Original measures developed by He and Wong, 2004) to measure exploitative innovation strategy. Objectives for undertaking innovation projects in the last 3 years (from 1 = "not important" to 5 = "very important") • Improve existing product quality • Improve production flexibility • Reduce production cost • Improve yield or reduce material consumption (Cronbach alpha 0.81)		
Brady and Davis (2004)	*Exploration:* Exploration refers to the innovative behaviour involved in risk-taking and experimenting with unfamiliar alternatives (2004:1604).			An empirical study of three projects launched by Ericsson and Cable &Wireless	
Auh and Menguc (2005)	*Exploration*		*Scale items for exploration* • Research and development expenditures for product development. • Research and development expenditures for process innovation. • Rate of product innovations • Innovations in marketing techniques (5-point Likert scales: 1 = "much less than competitors" to 5 = "much more than competitors").	A study of a sample of 260 manufacturing firms in Australia	
Atuahene-Gima (2005)	*Competence Exploration:* Competence exploration refers to the tendency of a firm to invest resources to acquire entirely new knowledge, skills, and processes (2005:62).		Over the last three years, to what extent has your firm 1. Acquired manufacturing technologies and skills entirely new to the firm? 2. Learned product development skills and processes (such as product design, prototyping new products, timing of new product introductions, and customizing products for local markets) entirely new to the industry? 3. Acquired entirely new managerial and organizational skills that are important for innovation (such as forecasting technological and customer trends; identifying emerging markets and technologies; 3. Coordinating and integrating R&D; marketing, manufacturing, and other functions; managing the product development process)? 4. Learned new skills in areas such as funding new technology, staffing R&D function, training and development of R&D, and engineering personnel for the first time? 5. Strengthened innovation skills in areas where it had no prior experience? (Composite reliability=0.83) (5-point scale format for each of these measures was 1 = "no extent" and 5 = "to a great extent")	A study of a sample of 127 electronics firms in China	Zhou and Wu (2010) (Exploration measurement items' Composite Reliability = 0.946)

Jansen, Van den Bosch and Volberda (2006)			Exploratory innovation • Our unit accepts demands that go beyond existing products and services. • We invent new products and services. • We experiment with new products and services in our local market. • We commercialize products and services that are completely new to our unit. • We frequently utilize new opportunities in new markets. • Our unit regularly uses new distribution channels. • We regularly search for and approach new clients in new markets.** Exploitative innovation • We frequently refine the provision of existing products and services. • We regularly implement small adaptations to existing products and services. • We introduce improved, but existing products and services for our local market. • We improve our provision's efficiency of products and services. • We increase economies of scales in existing markets. • Our unit expands services for existing clients. • Lowering costs of internal processes is an important objective** (1 = "strongly disagree" and 7 = "strongly agree") **item deleted by Jansen, Van den Bosch and Volberda (2006) after exploratory factor analysis	An empirical study conducted at a large, European, multi-unit financial services firm	
Yalcinkaya, Calantone and Griffith (2007)	*Exploration capabilities:* We define "exploration capabilities" as the importer's ability to adopt new processes, products, and services that are unique from those used in the past (2007:66).		Exploration Capabilities 1. Our firm chooses new approaches to processes, products and services that are different from those used in the past. 2. Our firm has included some new aspects to its processes, products and services compared to prior strategies. (Internal reliability=.70) (7-Point Likert Scale)	A study of a national sample of 500 U.S. importers.	
Ireland and Webb(2007)	*Exploration:* Exploration represents a learning process in which the firm attempts to significantly broaden and deepen its total stock of knowledge (2007:53).	Organizational characteristics of successful exploration *Operational:* • Use of *mergers and acquisitions* to gain full control over valuable, diverse resources and knowledge. • Use of *strategic alliances* to tap more external resources. • Use of *corporate venture capital* programmes to invest across a broad number of opportunities to keep aware of changes in the external environment. *Structural:* • Use of *decentralized authority* • Use of *semi-standardized procedures/Semi-formalized processes* *Cultural:* • Promoting experimentation • Willingness to face uncertainty/risk • Motivation to overlook failure		A conceptual paper.	
Greve (2007)	*Exploration:* Exploration is search for new knowledge, use of unfamiliar technologies, and creation of products with unknown demand (2007:945).		Exploration innovations were innovations that the sources described as involving development of new technology or application of existing technology not earlier used by the focal firm.	An empirical study in the Japanese shipbuilding industry.	
Quintana-Garcıa and Benavides-Velasco (2008)	*Exploratory innovative competence:* Exploratory innovative competence represents the ability to perform extensive searches that result in novel methods or materials technologically distant from existing innovations (2008:498).		*Measure of exploratory innovative competence* • The number of patents that depart completely from prior firm knowledge base and represent new knowledge to other firms and to the market.	A study among a sample of US dedicated biotechnology firms (DBFs)	

5. Exploitative Capabilities

Author/s and the Year	Equivalent Construct	Dimensions/Definitions	Original Measures	Research Context	Others Who Used This Work
March (1991)	*Exploitation;* Exploitation includes such things as refinement, choice, production, efficiency, selection, implementation, execution (1991: 71).			A conceptual paper	
Brady and Davis (2004)	*Exploitation*: Exploitation refers to the routine behaviour involved in refining a firm's current capabilities and improving the performance of existing routines (2004:1604).			An empirical study of three projects launched by Ericsson and Cable & Wireless	
Auh and Menguc (2005)			*Scale items for exploitation* • Modernization and automation of production processes. • Efforts to achieve economies of scale. • Capacity utilization (5-point Likert scale from 1 = "much less than competitors" to 5 = "much more than competitors")	A study of a sample of manufacturing firms in Australia	
Atuahene-Gima (2005)	*Competence exploitation:* Competence exploitation refers to the tendency of a firm to invest resources to refine and extend its existing product innovation knowledge, skills, and processes. Its aims are greater efficiency and reliability of existing innovation activities (2005:62).		Over the last three years, to what extent has your firm 1. Upgraded current knowledge and skills for familiar products and technologies? 2. Invested in enhancing skills in exploiting mature technologies that improve productivity of current innovation operations? 3. Enhanced competencies in searching for solutions to customer problems that are near to existing solutions rather than completely new solutions? 4. Upgraded skills in product development processes in which the firm already possesses significant experience? 5. Strengthened our knowledge and skills for projects that improve efficiency of existing innovation activities? (Composite reliability=0.86) (Scale format for each of these measures was from 1 = "no extent" to 5 = "to a great extent")	A study of a sample of 127 electronics firms in China	Zhou and Wu (2010) (Exploitation measurement items' Composite Reliability = 0.82)
Yalcinkaya,Calantone and Griffith (2007)	*Exploitation capabilities:* The importer's ability to improve continuously its existing resources and processes (2007:66).		1. Employees of our firm try to continuously improve the firm's processes, products and services. 2. Employees of our firm believe that improvement of the firm's processes, products and services is their responsibility. (Reliability =.76) (7-Point Likert Scale)	A national sample of 500 U.S. importers	
Ireland and Web (2007)	*Exploitation:* Exploitation rests on knowledge of a proven innovation (i.e. product, process, or administrative), making it possible for firms to be aware of present needs and demands (2007:53).	Organizational characteristics of successful exploitation: *Operational* • *Internal development* of intimate knowledge held by employees involved with exploitation activities is often sufficient to lead the firm's incremental innovation. • Use of *strategic alliances* to expand firm's knowledge and resources to accurately and quickly target global opportunities. • Use of *mergers and acquisitions* to gain full control over valuable distribution channels and establish economies-of-scale and –scope. *Structural* • Use of centralized authority; Use of standardized procedures/formalized processes *Cultural* • Need for certainty in outcomes; Preference for short-term goals;Commitment to focus		A conceptual paper	
Greve (2007)	Exploitation is use and refinement of existing knowledge, technologies, and products, and has more certain and proximate benefits (2007:945).		Exploitation innovations were the innovations that did not involve the firm learning or developing new technology.	An empirical study in the Japanese shipbuilding industry.	
Quintana-Garcıa and Benavides-Velasco (2008)	Exploitation improves methods or materials (2008:498).		The number of patents that include one or more citations or self-citations and are thus close to existing innovations that have been produced by the firm or other organizations.	A study among a sample of US dedicated biotechnology firms (DBFs)	
O'Reilly and Tushman (2008)	"Exploitation is about efficiency, increasing productivity, control, certainty, and variance reduction" (2008:189).			A conceptual paper	
Choi, Lévesque and Shepherd (2008)	*Opportunity exploitation:* building efficient, full-scale operations for products or services created by, or derived from, a business opportunity (2008:335).			A conceptual paper	

7. Firm Performance

Author/s and the Year	Equivalent Construct	Dimensions/Definitions	Original Measures	Research Context	Others Who Used This Work
Venkatraman and Ramanujam (1986)	*Firm performance*	*Financial performance* • Sales growth • Profitability (reflected by ratios such as return on investment, return on sale, and return on equity) • Earnings per share *Operational performance(non-financial/market performance)* • Market-share • New product introduction • Product quality • Marketing effectiveness • Manufacturing value-added • Other measures of technological efficiency		A conceptual paper	Terziovski (2010)
Baum, Calabrese and Silverman (2000)	*Firm performance*	Measured five dimensions of Biotechnology start-ups' performance:	1. Year-over-year revenue. 2. Year-over-year R&D spending growth. 3. Year-over-year employment growth in the number of non-R&D employees. 4. Year-over-year employment growth in the number of dedicated R&D employees. 5. Start-ups' patenting rate.	A study of a sample of 369 Canadian Biotechnology start-ups.	
Calantone, Cavusgil and Zaho (2002)	*Firm performance*		*Objective measures:* • Return on investment • Return on assets • Return on sales *Subjective measures:* • Overall profitability. (Scale reliability α = 0.85)	A study of a sample of 400 R&D vice presidents from a broad spectrum of US industries.	
Sawyerr, McGee and Peterson (2003)	*Firm performance*		During the past year. • Net income after taxes, • Total sales growth and • Return on assets (Reliability α= .85)	A sample of owner-managers from 153 small firms in the high technology SMEs in the US.	
He and Wong (2004)	*Firm performance*		▪ Average sales growth rate	A survey of innovation behaviour and performance of 206 manufacturing firms in Singapore and Penang, Malaysia.	
Wu et al.(2006)	*Financial performance*		• My BU performs much better than competitors in profitability. • My BU performs much better than competitors in ROI. • My BU performs much better than competitors in cash flow from operations. (Composite reliability = 0.92) (7-point Likert scale ranging from 1 = "strongly disagree" to 7 = "strongly agree")	Surveys among 184 supply chain and logistics managers in various industries.	
Morris et al.(2006)	*Firm growth*		Growth in 1.the amount of revenues, 2.the number of employees, 3.the physical location size at the time of the interview compared to the measure of the same variables at the start of the venture.	In-depth personal interviews with 50 female entrepreneurs located in upstate New York based on a cross-sectional mail survey among a random sample of 103 female entrepreneurs.	
Panigyrakis and Theodoridis (2007)	*Firm performance*		*Financial Performance:* • Total Sales • Growth Rate of Sales *Non-financial Indicators:* • Market Share • Space Productivity • Stock age The adopted indicators were determined during the in depth interviews and respondents were asked to evaluate each performance indicator in comparison to the largest competitor over the past 3 years (Panigyrakis and Theodoridis, 2007). (7-point Likert scale ranging from 1 = ''much worse'' to 7 = ''much better'') (Composite reliability: financial performance = 0.88 and non-financial performance = 0.72)	A study of a sample of 252 firms in the retail industry in Greece.	

Watson (2007)	Firm performance	Survival, growth and ROE	• Survival • growth in total income (sales plus other income) • ROE (return on equity)	A study of a sample of 5014 Australian SMEs.	
Watson and Robinson (2003)	Firm performance		• Average annual profit • Reward-to-variability ratio	A study of a sample of 2236 male-controlled SMEs and 131 female-controlled Australian SMEs	
Deshpande et al.(1993)	Business performance	• Size • Market share • Growth	Relative to our businesses' largest competitor, we are: 1. (a) Larger (b) About the same size (c) Smaller; 2. (a) Have a smaller market share (b) About the same market share (c) Have a larger market share; 3. (a) Are growing faster (b) Are growing more slowly(c) Are growing at about the same rate.	A study of a sample 50 firms that represented 200 individual respondents.	Darroch (2005)
Jaworski and Kohli (1993)	Business performance	• Judgmental (subjective) • Objective	• The judgmental measure asked informants for their assessment of the overall performance of the business and its overall performance relative to major competitors, rated on a 5-point scale ranging from "poor" to "excellent." • The objective measure was the dollar share of the served market.	A study of 222 business units (sample 1) and 230 individual informants (sample 2).	Darroch (2005)
Slater and Narver (1994)	Market performance	Relative performance (subjective)	• Market performance is measured as the top management team's assessment of the SBU's return on assets (ROA), sales growth, and new product success relative to all other competitors in the SBU's principal served market over the past year.	A study of a sample of 81 strategic business units (SBUs) in a forest products company and 36 SBUs in a diversified manufacturing corporation.	Appiah-Adu and Singh (1998)
Des and Robinson (1984)	Organisational performance	• Subjective measures • 'Self-reported' objective measures	• 'After tax return on total assets' • 'Growth in sales' • Two measures of what may be considered overall or 'global' organizational performance.	A study of a sample of 22 Privately-Held Firm and Conglomerate Business Unit.	
Hult et al. (2004)	Business performance		The scale for performance assessed • profitability, • growth in sales • market share, • general performance	A study of a sample of 181 US firms.	
Knight (2000)	Performance		Compared with the average of your three leading competitors, • The market share of our #1 largest volume product line is much smaller/much larger. • Our sales growth over the past three years has been much smaller/much larger. • Our average ROA (pre-tax net income divided by total assets) is presently much smaller/much larger. • Our pre-tax profitability is presently much smaller/much larger. • Our average return on investment over the last 3 years has been (check number).	A study of a sample of 216 SMEs.	
Li, Huang and Tsai (2009)	Firm performance		• Three items measured efficiency: return on investment, return on equity, and return on assets in the past three years. • Similarly, three items measured growth: sale growth, employee growth, and market share growth. • Three items measured profit: return on sales, net profit margin, and gross profit margin. •	A study of a sample of 165 firms of which the majority are small and medium enterprises in Taiwan.	
Lumpkin and Des (2006)	Firm performance		Performance was assessed by obtaining individual responses to three performance indices measured on a 7-point Likert scale ranging from 1 = low performer' to 7 = 'high performer'. • market share, • profitability and • return on investment, • overall company performance. The questionnaire asked executives to 'assess your organization's performance *over the past five years* relative to your competitors'.	A study of a sample of 32 firms	
Murphy, Trailer and Hill (1996)	Performance	• Financial versus operational (nonfinancial) measures.	Quick ratio Current ratio ROE ROI EPS Net income Number of employees Sale	51 published entrepreneurship studies using performance as the dependent variable were examined and data from a sample of 586 small businesses firms were used to analyse some of the more popular objective performance measures.	

Appendix 3: Operationalisation of Concepts and Measures Used in the Study

Concept	Dimensions	Original Measures	Measures Used in This Study	Others Who Used Those Measures.
The success trap As they [firms] develop greater and greater competence at a particular activity, they engage in that activity more, thus further increasing competence and the opportunity cost of exploration (Levinthal and March, 1993:106).	*The familiarity trap (FT)* A tendency to favour the familiar over the unfamiliar (Ahuja and Lampert, 2001:531). Firm works in a single technology, not exploring any others. However, in that single technology it usually works on the leading edge and often uses a very original approach in terms of addressing the problems in that technology (Ahuja and Lampert, 2001:531). *The maturity trap (MT)* A tendency to prefer the mature over the nascent (Ahuja and Lampert, 2001:531). Firm explores several technologies but usually works on mature technologies. Within these mature technologies it sometimes adopts a very original approach to addressing the problems in that technology. *The propinquity trap (PT)* A tendency to search for solutions that are near to existing solutions rather than search for completely new solutions (Ahuja and Lampert, 2001:531). Firm explores several technologies but usually works on leading-edge technologies. Within these leading-edge technologies it usually adopts an unoriginal approach, preferring to work on problems and solutions that have well established precedents (Ahuja and Lampert, 2001:531).		New measures developed in this study based on conceptual work by Levinthal and March (1993) and Ahuja and Lampert (2001)*. 1. Rather than trying to move into new technologies, this firm has been relying on a set of familiar technologies. (FT) 2. This firm has broken out its comfort zone of familiar technologies. (*reverse coded*).(FT) 3. This firm has been focussing on solving problems mainly through further development of mature technologies.(MT) 4. This firm prefers to adopt technologies which are well-established in the industry rather than emerging technologies in the industry.(MT) 5. This firm has been looking for new technologies/solutions which are close to existing technologies/solutions in the industry.(PT) 6. The tendency of this firm to look for solutions closer to existing solutions/technologies in the industry has been a barrier to develop pioneering solutions.(PT) (7-point Likert scales from1 = “strongly disagree” to 7 = “strongly agree”.) *The above three components (Ahuja and Lampert, 2001) are not separately measured in this study as the study is conducted in the context of high-tech SMEs and not large organisations. The new scale has been developed taking the characteristics of each component and taking the success trap as a unidimensional construct.	N/A
Market dynamism Environmental turbulence (Market dynamism) reflects rapid market and technological changes that managers perceive as hostile and stressful conditions for their firm (Atuahene-Gima, 2005:66).		Measures developed by (Atuahene-Gima, 2005) based on Jaworski and Kohil (1993). Indicate your degree of agreement about how well these statements describe the market and competitive environment during the last three years. 1. The actions of local and foreign competitors in our major markets were changing quite rapidly. 2. Technological changes in our industry were rapid and unpredictable. 3. The market competitive conditions were highly unpredictable. 4. Customers’ product preferences changed quite rapidly. 5. Changes in customers’ needs were quite unpredictable. (Interrater reliability r = 0.95) (5-point Likert scales from1= “strongly disagree” to 5= “strongly agree”)	Original measures developed by (Atuahene-Gima, 2005) based on Jaworski and Kohil (1993). Indicate your degree of agreement about how well these statements describe the market and competitive environment during the last three years. 1. The actions of local and foreign competitors in our major markets were changing quite rapidly. 2. Technological changes in our industry were rapid and unpredictable. 3. The market competitive conditions were highly unpredictable. 4. Customers’ product preferences changed quite rapidly. 5. Changes in customers’ needs were quite unpredictable. (7-point Likert scales from1 = “strongly disagree” to 7 = “strongly agree”.)	
The percentage of projects undertaken by the firm (a) *successful*, (b) *failed* (c) *ongoing*.				

Dynamic capabilities The firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments (Teece, Pisano and Schuen, 1997:516).	*Adaptive capability:* The capacity to reconfigure activities in the business unit quickly to meet changing demands in the task environment (Gibson and Brikinshaw, 2004:209).	Measures used in Gibson and Birkinshaw's (2004) empirical study among a sample of 4,195 individuals of 41 business units in ten multinational firms are adapted and used in this study. • The management systems in this organization encourage people to challenge outmoded traditions/practices/sacred cows (Gibson and Birkinshaw, 2004) (α=79). • The management systems in this organization are flexible enough to allow us to respond quickly to changes in our markets (Gibson and Birkinshaw, 2004) (α=.92). • The management systems in this organization evolve rapidly in response to shifts in our business priorities (Gibson and Birkinshaw, 2004) (α=.90). (Overall reliability of scales α=.80). (7-point Likert scale)	Measures used in Gibson and Birkinshaw's (2004) empirical study are adapted and used in this study. 1. People in this organization are encouraged to challenge outmoded traditions/practices/sacred cows (Adapted from Gibson and Birkinshaw, 2004). 2. This organization is flexible enough to allow us to respond quickly to changes in our markets (Adapted from Gibson and Birkinshaw, 2004). 3. This organization evolves rapidly in response to shifts in our business priorities (Adapted from Gibson and Birkinshaw, 2004).	Zhou and Li (2010) developed and used a scale based on Gibson and Brikinshaw (2004). The composite reliability = 0.78.
	Absorptive capability: The ability of a firm to recognize the value of new information, assimilate it, and apply to commercial ends (Cohen and Levinthal, 1990:128).	Measures developed and used by García-Morales, Llorens-Montes and Verdu –Jover (2008)in an empirical study among a sample of 408 organizations in Spain. 1. The organization has a clear division of roles and responsibilities for acquiring new knowledge. 2. The organization has the necessary skills to implement new acquired knowledge. 3. The organization has the competences to transform the new acquired knowledge. 4. The organization has the competences to use the new acquired knowledge. (Reliability of scales α = 0.85). (Seven-point Likert scale)	Measures developed and used by García-Morales, Llorens-Montes and Verdu–Jover (2008)in an empirical study among a sample of 408 organizations in Spain. 1. The organization has a clear division of roles and responsibilities for acquiring new knowledge. 2. The organization has the necessary skills to implement new acquired knowledge. 3. The organization has the competences to transform the new acquired knowledge. 4. The organization has the competences to use the new acquired knowledge. (Reliability of scales α = 0.85). (7-point Likert scale ranging from "Strongly disagree"=1 to "Strongly agree" =7).	
	Innovative capability: A firm's capability in introducing new products and production-service technologies, the searching for novel solutions to marketing and production problems, and attempting to lead rather than to follow competitors (proactiveness), and risk-taking (Adapted from Miller and Friesen,1983:222).	Original measures developed by Calantone, Cavusgil and Zaho (2002) to measure firm innovativeness. 1. Our company frequently tries out new ideas. 2. Our company seeks out new ways to do things. 3. Our company is creative in its methods of operation. 5. Our company is often the first to market with new products and services. 6. Innovation in our company is perceived as too risky and is resisted. 7. Our new product introduction has increased over the last 5 years. (Reliability α=.89) (7-point Likert scale, ranging from 1 = "strongly disagree" to 7 = "strongly agree") Behavioural innovativeness scale taken from the original construct developed and validated by Wang and Ahmed (2004) to measure organizational innovativeness. IN20: We get a lot of support from managers if we want to try new ways of doing things. IN25: In our company, we tolerate individuals who do things in a different way. IN26: We are willing to try new ways of doing things and seek unusual, novel solutions. IN27: We encourage people to think and behave in original and novel ways. (Reliability α = 0.87) (7-point Likert scale, ranging from 1 = "strongly disagree" to 7 = "strongly agree")	The measure adapted and used by Hughes and Morgan (2007) (Reliability α = 0.81) based on Calantone, Cavusgil and Zaho (2002) to measure innovativeness. *Innovativeness* 1. We actively introduce improvements and innovations in our business. 2. Our business is creative in its methods of operation. 3. Our business seeks out new ways to do things. (Reliability α = 0.81) (7-point Likert scale ranging from1 = "strongly disagree" to 7 = "strongly agree") Taken from the original items (IN20) developed and validated by Wang and Ahmed (2004). 4. We get a lot of support from managers if we want to try new ways of doing things. (Reliability = overall alpha value of 20 items was 0.91) (7-point Likert scale ranging from "strongly disagree"=1 to "strongly agree" =7).	

Exploratory capabilities Exploratory capabilities refer to the capabilities of a firm in acquiring entirely new knowledge, skills, and processes (Adapted from Atuahene-Gima, 2005).		Over the last three years, to what extent has your firm 1. Acquired manufacturing technologies and skills entirely new to the firm? 2. Learned product development skills and processes (such as product design, prototyping new products, timing of new product introductions, and customizing products for local markets) entirely new to the industry? 3. Acquired entirely new managerial and organizational skills that are important for innovation (such as forecasting technological and customer trends; identifying emerging markets and technologies; coordinating and integrating R&D; marketing, manufacturing, and other functions; managing the product development process)? 4. Learned new skills in areas such as funding new technology, staffing R&D function, training and development of R&D, and engineering personnel for the first time? 5. Strengthened innovation skills in areas where it had no prior experience? (Composite reliability=0.83) (Scale format for each of these measures was 1 = "no extent" and 5 = "to a great extent.")	Original measure of and those adapted from Atuahene-Gima (2005:69): 1. Acquired manufacturing technologies and skills entirely new to the firm? (Atuahene-Gima, 2005:69) 2. Learned product development skills and processes entirely new to the industry? (Adapted from Atuahene-Gima, 2005:69) 3. Acquired entirely new managerial and organizational skills that are important for innovation? (Adapted from Atuahene-Gima, 2005:69) 4. Learned new skills in areas such as funding new technology, staffing R&D function, training and development of R&D, and engineering personnel for the first time? (Atuahene-Gima, 2005:69) 5. Strengthened innovation skills in areas where it had no prior experience? (Atuahene-Gima, 2005:69) (7-point Likert scale ranging from "strongly disagree"=1 to "strongly agree" =7).	
Exploitative capabilities Exploitative capabilities refer to the capabilities of a firm in refining and extending its existing product innovation knowledge, skills, and processes (Adapted from Atuahene-Gima, 2005:62).		Over the last three years, to what extent has your firm 1. Upgraded current knowledge and skills for familiar products and technologies? 2. Invested in enhancing skills in exploiting mature technologies that improve productivity of current innovation operations? 3. Enhanced competencies in searching for solutions to customer problems that are near to existing solutions rather than completely new solutions? 4. Upgraded skills in product development processes in which the firm already possesses significant experience? 5. Strengthened our knowledge and skills for projects that improve efficiency of existing innovation activities? (Composite reliability=0.86) (Scale format for each of these measures was 1 = "no extent" and 5 = "to a great extent.")	Original measure of Atuahene-Gima (2005:69): 1. Upgraded current knowledge and skills for familiar products and technologies? 2. Invested in enhancing skills in exploiting mature technologies that improve productivity of current innovation operations? 3. Enhanced competencies in searching for solutions to customer problems that are near to existing solutions rather than completely new solutions? 4. Upgraded skills in product development processes in which the firm already possesses significant experience? **5.** Strengthened our knowledge and skills for projects that improve efficiency of existing innovation activities? (7-point Likert scale ranging from "strongly disagree"=1 to "strongly agree" =7).	
Firm performance	*Financial performance*	*Financial performance* Measures proposed by Venkatraman and Ramanujam (1986): • Sales growth • Profitability (reflected by ratios such as return on investment, return on sale, and return on equity) • Earnings per share Measures used by Wu et al. (2006): 1. My BU performs much better than competitors in profitability. 2. My BU performs much better than competitors in ROI. 3. My BU performs much better than competitors in cash flow from operations. (Composite reliability = 0 .92) (7-point Likert scale ranging from 1 = "strongly disagree" to 7 = "strongly agree")	Measures used in this study to measure firm performance. 1. Sales growth (Venkatraman and Ramanujam, 1986). 2. Growth in profitability (Wu et al., 2006). 3. Year-over-year employment growth in the number of employees (Adapted from Baum, Calabrese and Silverman, 2000). 4. Growth in the physical location size over the last three years (Adapted from Morris et al. (2006).	He and Wong (2004), and Panigyrakis and Theodoridis (2007) used sales growth as a measure of firm performance.

	Operational performance (non-financial/market performance)	*Operational performance(non-financial/market performance)* • Market-share • New product introduction • Product quality • Marketing effectiveness • Manufacturing value-added (Venkatraman and Ramanujam, 1986)		
	Firm performance	1. Year-over-year revenue. 2. Year-over-year R&D spending growth. 3. Year-over-year employment growth in the number of non-R&D employees. 4. Year-over-year employment growth in the number of dedicated R&D employees. 5. Startups' patenting rate. (Baum, Calabrese and Silverman, 2000) During the past year. 1. Net income after taxes, 2. Total sales growth and 3. Return on assets (Reliability α= .85) (Sawyerr, McGee and Peterson, 2003)		
		• Revenue growth (Thornhill, 2006)		
		New venture performance: 1. Subjective measures(non-financial dimension) relative to competitors: • *sales growth,* • *employment growth,* • *market share,* • *gross profits,* • *net profit margin,* • *innovation in products and services,* • *speed in developing new products and services,* • *quality of products and services,* • *cost control, and* • *customer satisfaction.* (Respondents used a scale ranging from 1= "much worse," to 7 = "much better" to rate the above items as compared with their competitors) (Reliability α = .80). 2. Objective performance measure: • *sales growth* (Stam and Elfring, 2008)		
	Firm growth	Morris et al. (2006) compared the following indicators at the time of the interview with those at the start of the venture: growth in 1. the amount of revenues, 2. the number of employees, 3. the physical location size Zahra and Bogner (1999) used: • growth in market share (GMS) (Inter-rater reliability = 0.86)		

Appendix 4: Ethics Statement of the Study

Ethics Statement of the Doctoral Research by Prabhashwara Chaminda Senaratne, The School of Management, Royal Holloway University of London

I Prabhashwara Chaminda Senaratne, a doctoral researcher at the School of Management, Royal Holloway University of London, hereby state that my doctoral research on firm level entrepreneurship, which is carried out under the supervision of Dr. Catherine L. Wang, Reader in Strategy and Entrepreneurship and the advice of Dr.Hui Tan, Reader in Strategy, will be in compliance with the ethics and the regulations of the School of Management, Royal Holloway and those of University of London.

The research, a cross-sectional study, mainly focuses on the role of dynamic capabilities in exploration and exploitation by technology-based firms in the UK. Both qualitative and quantitative methods will be adopted in this research.

1. Survey
A questionnaire survey will be conducted among a sample of 2000[1] high-tech firms in Oxford, Cambridge, Reading and London[2] will be randomly selected from the Financial Analysis Made Easy/MINT[3] databases. A postal questionnaire will be sent to the CEOs/Directors, followed by a reminder and another copy of the questionnaire in three weeks. Based on an estimated response rate of 10%, 200 completed responses will be collected.

Survey data will be used only for the purpose of the research and the firms and individuals involved will be kept anonymous in the thesis and all the other publications based on the research. Any details that reveal the identity of firms and individuals collected in the survey will be kept strictly confidential during and after the research.

2. Semi-structured interviews
Semi-structured, face-to-face/telephonic interviews will be conducted to collect qualitative data. Out of the total number of effective responses, twenty firms willing to participate in the study will be selected for the interviews. In each company, senior executive will be interviewed resulting in 20 interviews in total. Furthermore, the voice recording of the interviews will be done subject to prior consent obtained from the interviewees.

Interview data will be transcribed and used only for the purpose of the research and the firms and individuals participated in the case studies will be kept anonymous in the thesis and all the other publications based on the research. Any details that reveal the identity of firms and individuals gathered in the case studies/interviews will be kept strictly confidential during and after the research.

In addition to the above, the purpose of the research will be clearly communicated to the participants. The participation of firms/individuals in the survey/interviews will be voluntary and they may withdraw at any time. Furthermore, I do hereby state that the research does not involve any human or animal experiments.

I kindly request your approval for the above ethics statement of my doctoral research.

Yours sincerely
Prabhashwara Chaminda Senaratne
Doctoral Researcher
Date:22 October 2009

Approved by the Ethics Committee:

PhD Programme Director, School of Management
Date: 13 November 2009

NOTE: 1. The total sample that met the criteria of the study was 1211; 2. During the process of the study, the sample was extended to the high-tech SMEs across the entire UK; 3. During the process of the study, it was decided to use the Experian database considering its most up-to-date information and also the issues of accessing the Financial Analysis Made Easy (FAME) and MINT databases.

Appendix 5: The Mail Survey Cover Letter

(Date)
(Position)
(Name of the firm)

Dear (Name of the intended informant),

A Survey on Entrepreneurship in UK High-Tech Firms

I am a doctoral researcher at Royal Holloway, University of London. As a part of my doctoral research, I am conducting a survey on entrepreneurial activities in small and medium sized (SMEs) high-tech firms.

In particular, I am investigating into what makes some firms more entrepreneurial than others. This can be coming up with new technologies and products, identifying new market opportunities, and becoming more responsive to market opportunities. The results of the study will be useful in understanding how SMEs can upgrade their skills and capabilities to face market challenges.

This research is commissioned by the Central Research Fund of University of London. The research complies with the ethical codes of Royal Holloway, University of London. I can assure you that all the information you provide in this survey will be treated with strict confidentiality. The names of individuals and organisations will not be disclosed under any circumstances, and only the researcher will have access to the information. The results of the survey will be reported in statistical format.

Should you need more information about this research project, please feel free to contact me or my research supervisor, Professor Catherine Wang (Catherine.Wang@rhul.ac.uk), Royal Holloway, University of London.

Your participation in the survey is important to the success of the project, and your contribution is highly appreciated. As a token of appreciation, I will provide you with an Executive Summary of the research findings within six months of completing the study. In addition, participating in the survey will make you eligible for a prize draw for a £100 Marks & Spencer gift voucher.

I have enclosed a copy of the questionnaire and a self-addressed stamped envelope. It is greatly appreciated if you could take 20 minutes of your valuable time and fill out the questionnaire and return to me by (date). If you are not in a position to fill out the questionnaire due to your busy schedule or for any other reason, I would like you to forward the questionnaire to or recommend me by e-mail a suitable person in your firm such as New Product Development Manager, Business Development Manager, or Marketing Manager who would be able to fill it out.Thank you very much in advance for your time spent on answering the questionnaire and for your help in making this important research a success.

Yours sincerely,

Chaminda Senaratne
Doctoral Researcher
School of Management, Royal Holloway, University of London,
Egham, Surrey
TW20 0EX
United Kingdom

Appendix 6: The Survey Questionnaire

Entrepreneurship in UK High-Tech Firms

A Survey Conducted by

Chaminda Senaratne
Doctoral Researcher
School of Management, Royal Holloway, University of London,
Egham, Surrey,
TW20 0EX.
Tel: +44(0)7975504601
Fax:+44(0)1784276100
Email: Chaminda.Senaratne.2008@live.rhul.ac.uk

A. Would you like to receive a complimentary **copy of the Executive Summary** of this study? ☐Yes. ☐No.

B. Would you like to participate in **a prize draw of £100 Marks and Spencer gift voucher?** ☐Yes. ☐No.

If you answered "**yes**" to any of the above questions, please provide a contact e-mail address below:

_____

SECTION 1. ABOUT YOUR FIRM

1. When was this firm originally established? Year_____
2. How many people do you currently employ? Please tick (✓) in the relevant box.

☐ 1-9 ☐ 10-49 ☐ 50-99 ☐ 100-149
☐ 150-249 ☐ 250-499 ☐ 500-999 ☐ 1000 or above

3. Does this firm/business unit belong to a parent company?

☐ Yes. The parent company is(Optional) _____
☐ No.

4. What industry do you consider your business operates in? _____

SECTION 2. THE BUSINESS ENVIRONMENT OF YOUR FIRM

Please circle a relevant number to indicate your degree of agreement about how well these statements describe the market and competitive environment of this firm during the last three years.

	Strongly Disagree						Strongly Agree
1. The actions of local and foreign competitors in our major markets were changing quite rapidly.	1	2	3	4	5	6	7
2. Technological changes in our industry were rapid.	1	2	3	4	5	6	7
3. Technological changes in our industry were unpredictable.	1	2	3	4	5	6	7
4. The market competitive conditions were highly unpredictable.	1	2	3	4	5	6	7
5. Customers' product preferences changed quite rapidly.	1	2	3	4	5	6	7
6. Changes in customers' needs were quite unpredictable.	1	2	3	4	5	6	7

SECTION 3. SKILLS AND CAPABILITIES OF YOUR FIRM

Please circle a relevant number to indicate to what extent you agree or disagree with each of the following statements.

	Strongly Disagree						Strongly Agree
1. People in this firm are encouraged to challenge outmoded practices.	1	2	3	4	5	6	7
2. This firm is flexible enough to allow us to respond quickly to changes in our markets.	1	2	3	4	5	6	7
3. This firm evolves rapidly in response to shifts in our business priorities.	1	2	3	4	5	6	7
4. This firm has a clear division of roles and responsibilities for acquiring new knowledge.	1	2	3	4	5	6	7
5. This firm has the necessary skills to implement newly acquired knowledge.	1	2	3	4	5	6	7
6. This firm has the competences to transform the newly acquired knowledge.	1	2	3	4	5	6	7
7. This firm has the competences to use the newly acquired knowledge.	1	2	3	4	5	6	7

8.	This firm introduces improvements and innovations in its business.	1	2	3	4	5	6	7
9.	This firm is creative in its methods of operation.	1	2	3	4	5	6	7
10.	This firm seeks out new ways of doing things.	1	2	3	4	5	6	7
11.	People in this firm get a lot of support from managers if they want to try new ways of doing things.	1	2	3	4	5	6	7

12. The number of key changes in systems and practices implemented in the firm over the past three years:

    (a) that are based on new ideas of people **inside** the firm:_____

    (b) that are based on new ideas from sources **outside** the firm: _____

13. The number of new products introduced by the firm over the past three years:

    1. Radically new products:_____ (b) Incrementally new products:_____

SECTION 4. LEARNING AND TECHNOLOGIES IN YOUR FIRM

Please circle a relevant number to indicate to what extent you agree or disagree with each of the following statements relating to the core technologies of the firm.

		Strongly Disagree						Strongly Agree
1.	Rather than trying to move into new technologies, this firm has been relying on a set of familiar technologies.	1	2	3	4	5	6	7
2.	This **firm has broken out its comfort zone of familiar** technologies.	1	2	3	4	5	6	7
3.	This firm has been focusing on solving problems mainly through further development of mature technologies.	1	2	3	4	5	6	7
4.	This firm prefers to adopt technologies which are well-established in the industry rather than untested technologies in the industry.	1	2	3	4	5	6	7
5.	The tendency of this firm to look for solutions closer to existing technologies in the industry has been a barrier to develop pioneering solutions.	1	2	3	4	5	6	7
6.	This firm has been looking for new technologies that are fundamentally different from existing technologies in the industry.	1	2	3	4	5	6	7

SECTION 5. CORE BUSINESS ACTIVITIES OF YOUR FIRM

Please circle a relevant number to indicate to what extent you agree or disagree with each of the following statements.

Over the last three years this firm has	Strongly Disagree						Strongly Agree
1. Acquired manufacturing technologies and skills entirely **new to the firm**.	1	2	3	4	5	6	7
2. Learned product development skills and processes entirely **new to the industry.**	1	2	3	4	5	6	7
3. Acquired entirely new managerial and organizational skills that are important for innovation.	1	2	3	4	5	6	7
4. Learned new skills in areas such as funding new technology, staffing R&D function, training and development of R&D, and engineering personnel for the first time.	1	2	3	4	5	6	7
5. Strengthened innovation skills in areas where it had no prior experience.	1	2	3	4	5	6	7
6. Upgraded current knowledge and skills for familiar products and technologies.	1	2	3	4	5	6	7
7. Invested in enhancing skills in exploiting mature technologies that improve productivity of current innovation operations.	1	2	3	4	5	6	7
8. Enhanced competencies in searching for solutions to customer problems that are near to existing solutions rather than completely new solutions.	1	2	3	4	5	6	7
9. Upgraded skills in product development processes in which the firm already possesses significant experience.	1	2	3	4	5	6	7
10. Strengthened its knowledge and skills for projects that improve efficiency of existing innovation activities.	1	2	3	4	5	6	7

11. In the last three years, on average what percentage of the sales turnover was invested in **Research & Development**? ____%

    Alternatively, please tick (✓) one box only.

    ☐ 0 ☐ 0-4.99% ☐ 5-9.99% ☐ 10-14.99% ☐ 15-19.99% ☐ 20-24.99% ☐ 25-29.99%

    ☐ 30-34.99% ☐ 35-39.99% ☐ 40-44.99% ☐ 45-49.99% ☐ 50% or above

12. In the last three years, on average what percentage of the sales turnover was invested in **marketing**?____%

    Alternatively, please tick(✓) one box only.

    ☐ 0 ☐ 0-4.99% ☐ 5-9.99% ☐ 10-14.99% ☐ 15-19.99% ☐ 20-24.99% ☐ 25-29.99%

    ☐ 30-34.99% ☐ 35-39.99% ☐ 40-44.99% ☐ 45-49.99% ☐ 50% or above

13. How many patents has the firm obtained so far in total? _____

    Alternatively, please tick(✓) one box only.

    ☐ 0 ☐ 1-2 ☐ 3-4 ☐ 5-6 ☐ 7-8 ☐ 9-10 ☐ 10 or above

SECTION 6. PERFORMANCE OF YOUR FIRM

1. Please mention the annual average growth (%) in the following areas in 2010.

   a. Sales growth _____(%).
   b. Growth in profitability _____(%).
   c. Increase in the number of employees _____(%).
   d. Increase in the size of business premises_____(%).

2. As compared with 2008, the annual average growth (%) in each of the following areas in 2010 was

	Much Worse						Much Better
a. Sales growth	1	2	3	4	5	6	7
b. Growth in profitability	1	2	3	4	5	6	7
c. Increase in the number of employees	1	2	3	4	5	6	7
d. Increase in the size of business premises	1	2	3	4	5	6	7

SECTION 7. ABOUT YOURSELF

Please tick (✓) the relevant box/write the answer in the space given.

1. Your gender: ☐ Male ☐ Female
2. Your age group: ☐ <30 ☐ 30-39 ☐ 40-49 ☐ 50-59 ☐ >60
3. What is your position/job title? _____
4. How long have you worked in this company? _____ year(s) _____month(s)
5. How long have you worked in this industry? _____year(s) _____month(s)
6. Would you like to participate in further research related to this project?
   ☐ Yes ☐ No

SECTION 8: PLEASE PROVIDE FURTHER COMMENTS IN THE FOLLOWING SPACE.

a. What are the key challenges in the industry?

b. How does your firm intend to meet the challenges?

c. What new resources/capabilities do you need to achieve the above?

THANK YOU VERY MUCH.

Appendix 7: The Request Letter for the Interviews

(Date)
Dear (Name of the intended interviewee),

A Study on Entrepreneurship in UK High-Tech Firms

I am a doctoral researcher at Royal Holloway, University of London. As a part of my doctoral research on entrepreneurial activities in small and medium sized (SME) UK high-tech firms, I am conducting interviews with senior managers/managers of selected high-tech firms.

The interviews focus on what makes some firms more entrepreneurial than others. This can be coming up with new technologies and products, identifying new market opportunities, and becoming more responsive to market opportunities. The results of the research will be useful in understanding how SMEs can upgrade their skills and capabilities to face market challenges.

This research is commissioned by the Central Research Fund of University of London. The research complies with the ethical codes of Royal Holloway, University of London. I can assure you that all the information you provide will be treated with strict confidentiality. The names of individuals and organisations will not be disclosed under any circumstances, and only the researcher will have access to the information.

Your contact details were accessed via (database) and I have identified your firm as an innovative firm in the (industry) in the UK and your participation is very important to the success of the research. Therefore, it is highly appreciated if you could kindly give me an appointment for a 30-60 minute interview (face-to-face or telephonic interview) with you at your convenience or recommend any other senior manager/manager of your firm for an interview.

As a token of appreciation, I will provide you with an Executive Summary of the research findings within six months of completing the study.

Should you need more information about this research project, please feel free to contact me or my research supervisor, Professor Catherine Wang (Catherine.Wang@rhul.ac.uk), Royal Holloway, University of London.

I look forward to hearing from you.

Best regards

Chaminda Senaratne
Doctoral Researcher
School of Management, Royal Holloway, University of London,
Egham, Surrey
TW20 0EX
United Kingdom
Tel: 0797 5504601

Appendix 8: The Interview Guide

Entrepreneurship in the UK High-Tech Firms
The Interview Guide

About yourself

1. Can you tell me about your background in this firm?
    a. How long have you been working in this firm?
    b. What are your roles and responsibilities?
    c. How long have you been working in this industry?
    d. Briefly describe the general background you are from.

About your company

2. Can you give me an overview of the firm?
    a. When was the firm established?
    b. What is the structure of the company? Does this firm belong to any parent company?
    c. How many people do you employ here?
    d. What are the products/services offered by the firm?
    e. What are the turning points or critical moments in the history of this firm?

The business environment

3. How would you describe the market environment of this firm?
    a. What are the main markets of your firm?
    b. How is the competition from local and foreign competitors in your major markets? Do their moves rapid? Are they unpredictable?
    c. Has technological changes in this industry been rapid and/or unpredictable?
    d. Has product preferences (choice of products) of customers' in these markets changed rapidly?
    e. Has the changes in needs of the customers' (need for different products and services) in these markets been unpredictable?

Skills and capabilities

4. Can you describe how this firm coped with the changes in the external (market environment) and within the firm, in its development stages?
    a. How did the firm respond to them?
    b. What resources or capabilities advantages and resource constraints did your company have?
    c. How did your company adapt its resources or capabilities to suit the best strategy to capitalise on the changes in the environment? (How did the management systems encourage people to change the company's traditions/practices etc?)
    d. To what extent did your company acquire new information, assimilate with existing knowledge/create new knowledge and use that knowledge to coping with the changes? How did you manage it?
    e. How innovative was the company in developing new solutions, products, processes, systems, technologies and search for new markets in those difficult situations?

Learning and technologies

5. What are the core technologies and capabilities used in this firm?
    a. Has this firm been relying on a set of familiar technologies/capabilities? If yes, what do you think the reason/s for that?
    b. Has this firm been focusing on solving problems mainly through further development of mature technologies/capabilities rather than adopting untested new technologies in the industry? If yes, what do you think the reason/s for that?
    c. Do you think this firm has kept investing its resources in similar kind of projects that have failed have not resulted in new technologies/capabilities? (Has this firm made similar failures/mistakes when working on new projects?) If yes, what do you think the reason/s for that?

Core business activities

6. What do you think as the main focus of this firm in its core business activities? Coming up with new technologies and products, identifying new market opportunities (e.g. inventing a new product), AND/OR becoming more responsive to opportunities available in the market (e.g. offering a new product invented by a competitor for a cheaper price).
    a. Is R&D a key function of this firm?
    b. How much resources (e.g. financial, human and other resources) have you allocated for R&D?
    c. Has this firm
        a) acquired any manufacturing technologies and skills entirely new to the firm,
        b) learned product development skills and processes entirely new to the industry,
        c) acquired entirely new managerial and organizational skills that are important for innovation? (e.g. new skills in areas such as funding new technology, staffing R&D function, training and development of R&D and engineering personnel for the first time)

    AND/OR

    d. Has this firm
        a) upgraded current knowledge and skills for familiar products and technologies,
        b) invested in enhancing skills in exploiting mature technologies that improve productivity of current innovation operations,
        c) upgraded skills in product development processes in which the firm already possesses significant experience,
        d) strengthened the firm's knowledge and skills for projects that improve efficiency of existing innovation activities?
    e. How important is the marketing function for this firm?
    f. How much resources (e.g. financial, human and other resources) have you allocated for marketing?

Performance

7. How has the firm been doing in terms of its performance?
    a. As compared with the key competitors, what is the growth of the firm's
        i. sales,
        ii. profitability,
        iii. number of employees, and
        iv. the size of the premises in 2009?
    b. How was it in 2010/2011 as compared with 2007 and 2008?

General

8. What are the key challenges in the industry?
9. How does your firm intend to meet the challenges?
10. What new resources/capabilities do you need to achieve the above?

Thank You.

Appendix 9: Chi-Square Test: Non-Response Bias

Crosstabulation: Early and Late Responses vs. Firm Size

			Firm Size			Total
			Micro	Small	Medium	
Response Time	Early	Count	14	16	24	54
		% within Response Time	25.9%	29.6%	44.4%	100.0%
		% of Total	12.4%	14.2%	21.2%	47.8%
	Late	Count	9	29	21	59
		% within Response Time	15.3%	49.2%	35.6%	100.0%
		% of Total	8.0%	25.7%	18.6%	52.2%
Total		Count	23	45	45	113
		% within Response Time	20.4%	39.8%	39.8%	100.0%
		% of Total	20.4%	39.8%	39.8%	100.0%

Chi-Square Tests: Firm Size

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4.831[a]	2	.089
Likelihood Ratio	4.884	2	.087
Linear-by-Linear Association	.016	1	.898
N of Valid Cases	113		

NOTE: a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 10.99.

Symmetric Measures: Firm Size

		Value	Approx. Sig.
Nominal by Nominal	Phi	.207	.089
	Cramer's V	.207	.089
N of Valid Cases		113	

Crosstabulation: Early and Late Responses vs. Firm Age

			Firm Age				Total
			New	Young	Adult	Old	
Response Time	Early	Count	9	10	17	18	54
		% within Response Time	16.7%	18.5%	31.5%	33.3%	100.0%
		% of Total	8.0%	8.8%	15.0%	15.9%	47.8%
	Late	Count	10	6	23	20	59
		% within Response Time	16.9%	10.2%	39.0%	33.9%	100.0%
		% of Total	8.8%	5.3%	20.4%	17.7%	52.2%
Total		Count	19	16	40	38	113
		% within Response Time	16.8%	14.2%	35.4%	33.6%	100.0%
		% of Total	16.8%	14.2%	35.4%	33.6%	100.0%

Chi-Square Test: Firm Age

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.840[a]	3	.606
Likelihood Ratio	1.851	3	.604
Linear-by-Linear Association	.172	1	.678
N of Valid Cases	113		

NOTE: a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 7.65.

Symmetric Measures: Firm Age

		Value	Approx. Sig.
Nominal by Nominal	Phi	.123	.633
	Cramer's V	.123	.633
N of Valid Cases		113	

Crosstabulation: Early and Late Responses vs. Industry Type

			Industry According to SIC Classification					
			Aerospace	Pharmaceutical and Biotech	Office and Computing	Radio, TV and Communication	Medical and Optical Equipment	Total
Response Time	Early	Count	4	5	19	13	13	54
		% within Response Time	7.4%	9.3%	35.2%	24.1%	24.1%	100.0%
		% of Total	3.5%	4.4%	16.8%	11.5%	11.5%	47.8%
	Late	Count	12	6	17	12	12	59
		% within Response Time	20.3%	10.2%	28.8%	20.3%	20.3%	100.0%
		% of Total	10.6%	5.3%	15.0%	10.6%	10.6%	52.2%
Total		Count	16	11	36	25	25	113
		% within Response Time	14.2%	9.7%	31.9%	22.1%	22.1%	100.0%
		% of Total	14.2%	9.7%	31.9%	22.1%	22.1%	100.0%

Chi-Square Tests: Industry Type

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4.069[a]	4	.397
Likelihood Ratio	4.247	4	.374
Linear-by-Linear Association	2.385	1	.122
N of Valid Cases	113		

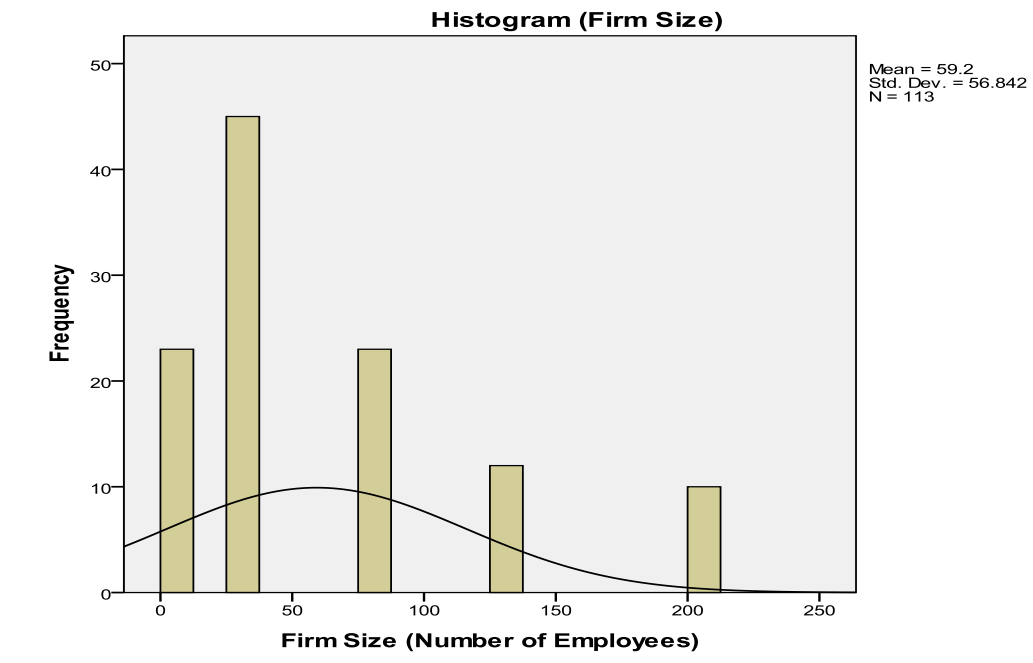
NOTE: a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 5.26.

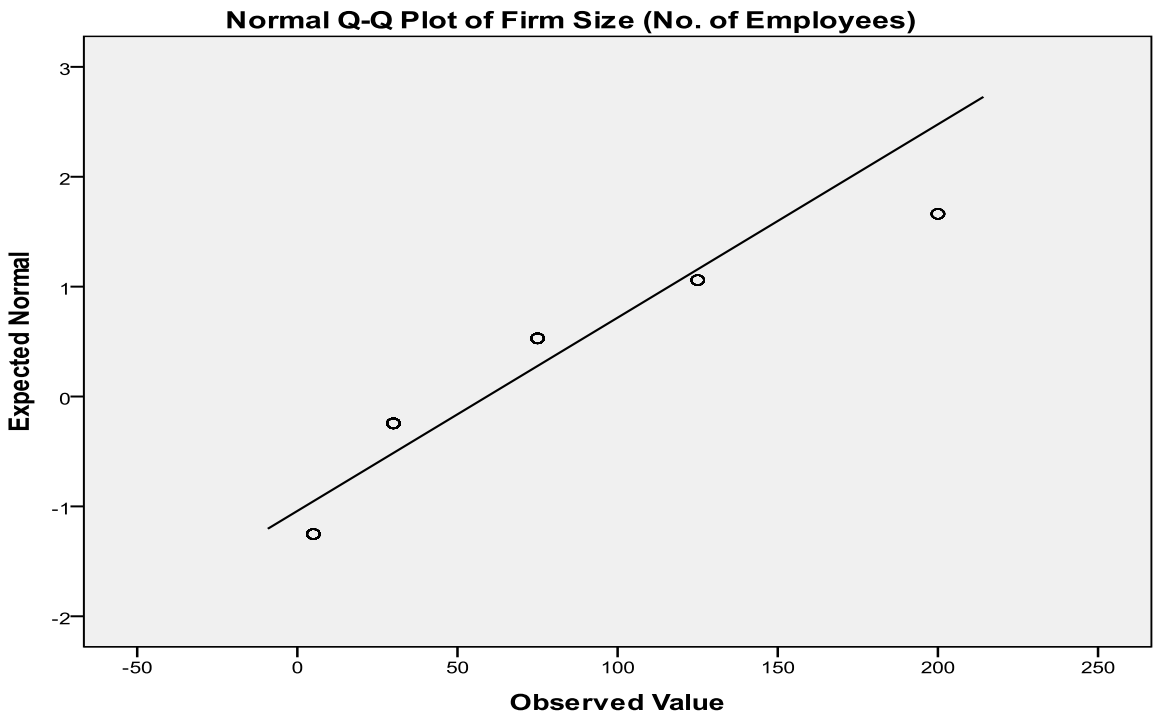
Symmetric Measures: Industry Type

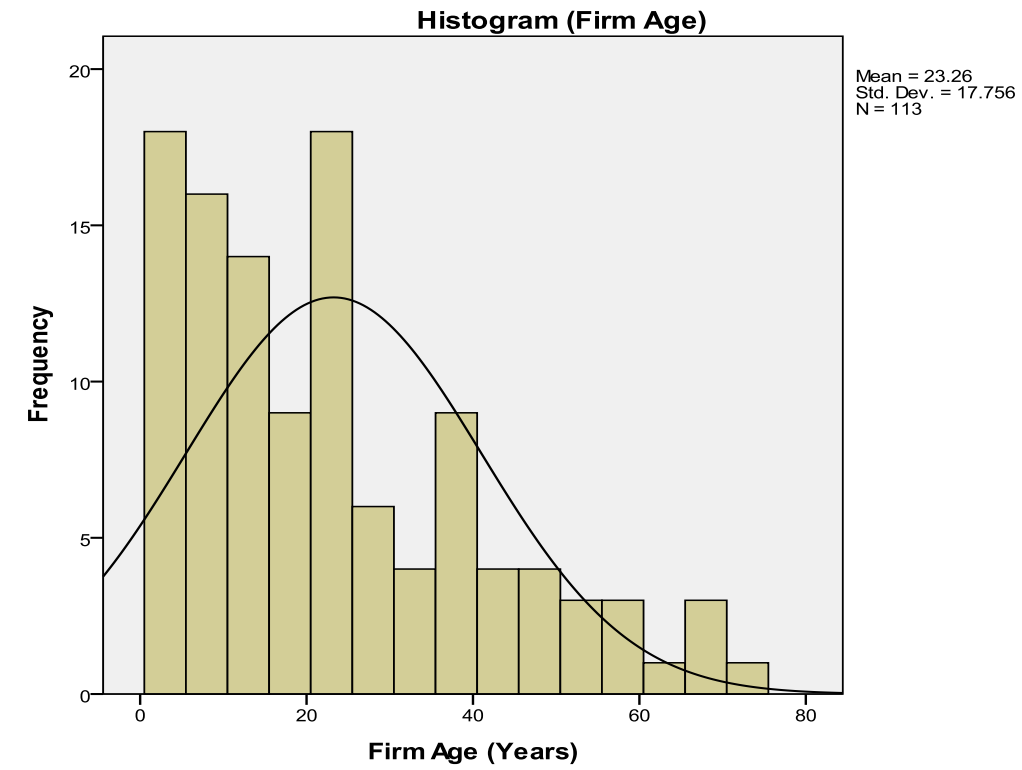
		Value	Approx. Sig.
Nominal by Nominal	Phi	.190	.397
	Cramer's V	.190	.397
N of Valid Cases		113	

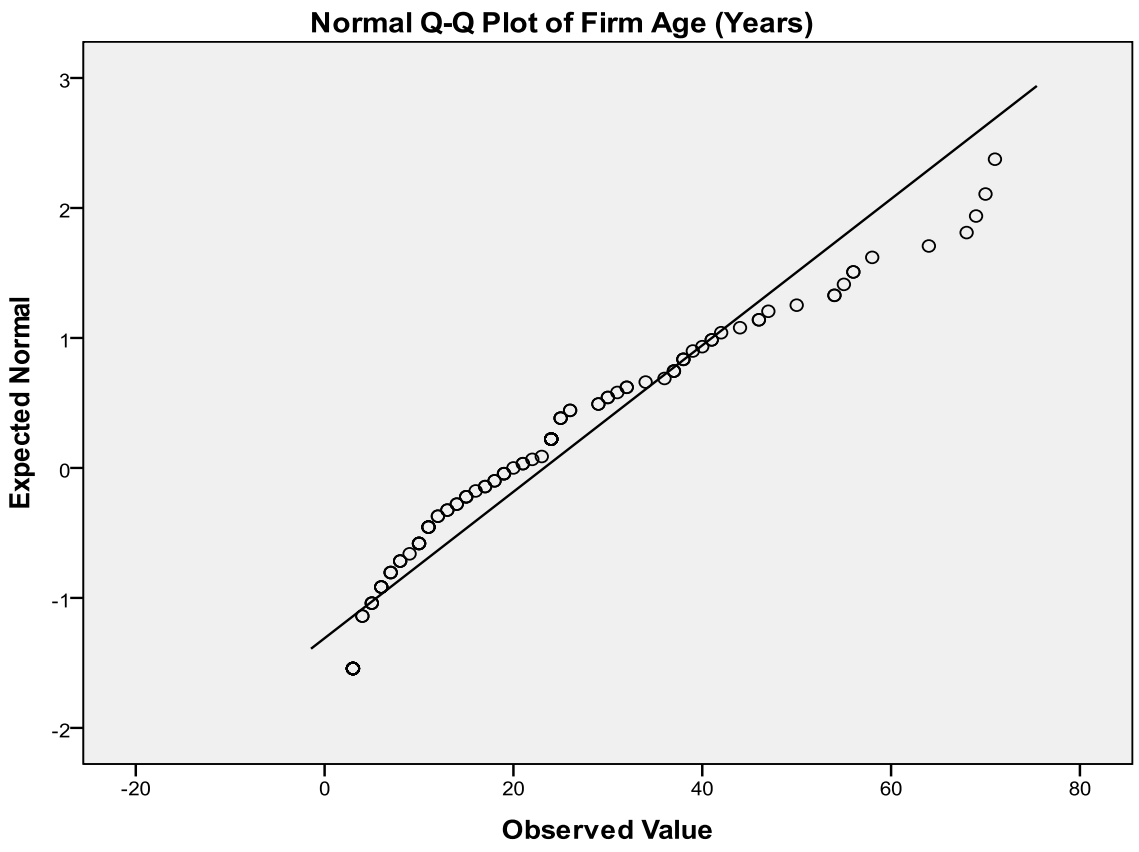
Appendix 10: Data Screening

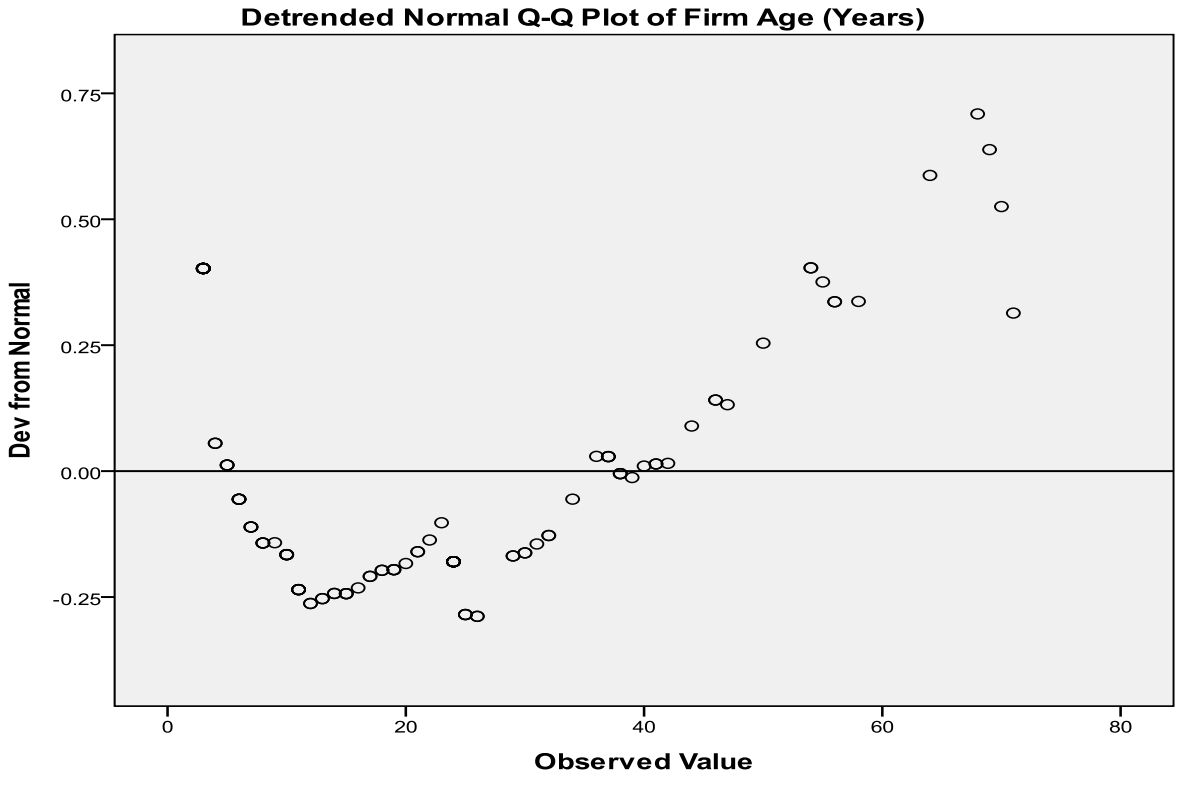
1. Test of Normality (Graphical Methods)

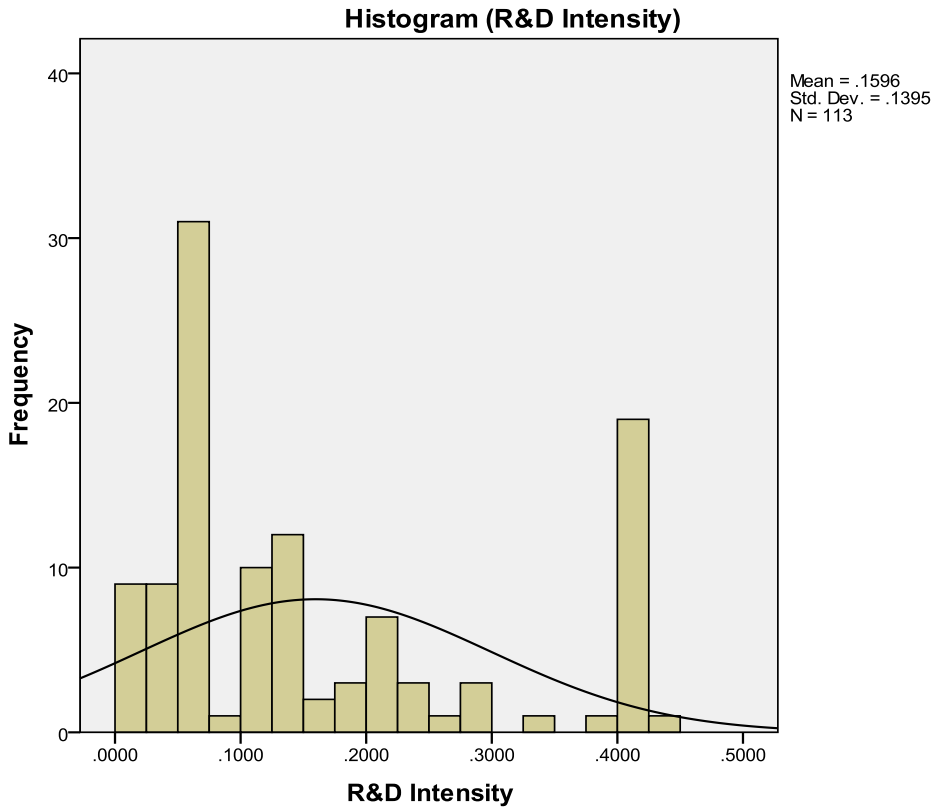


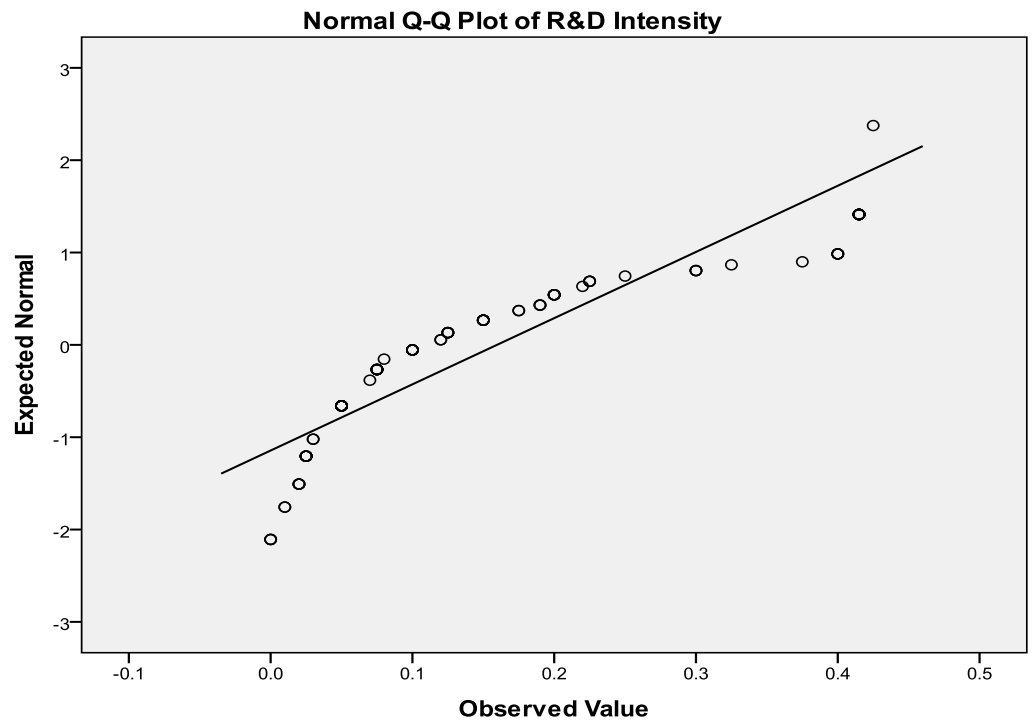


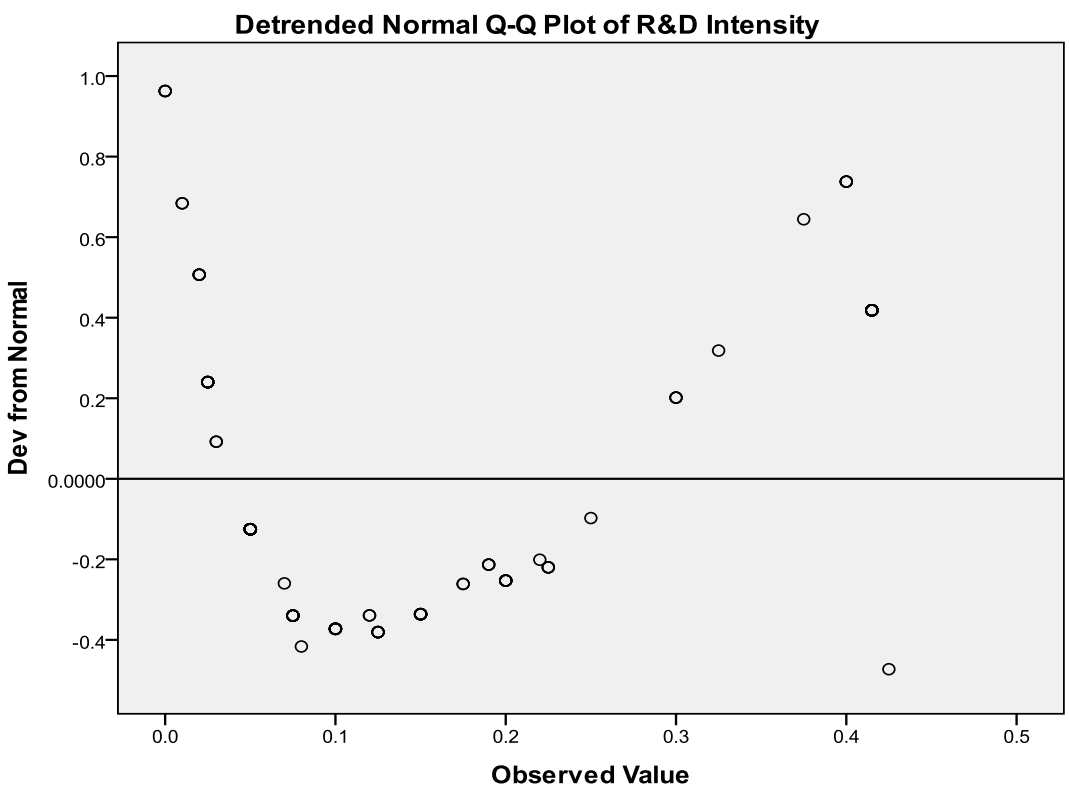

Histogram (Firm Age)
Mean = 23.26
Std. Dev. = 17.756
N = 113
Frequency
Firm Age (Years)

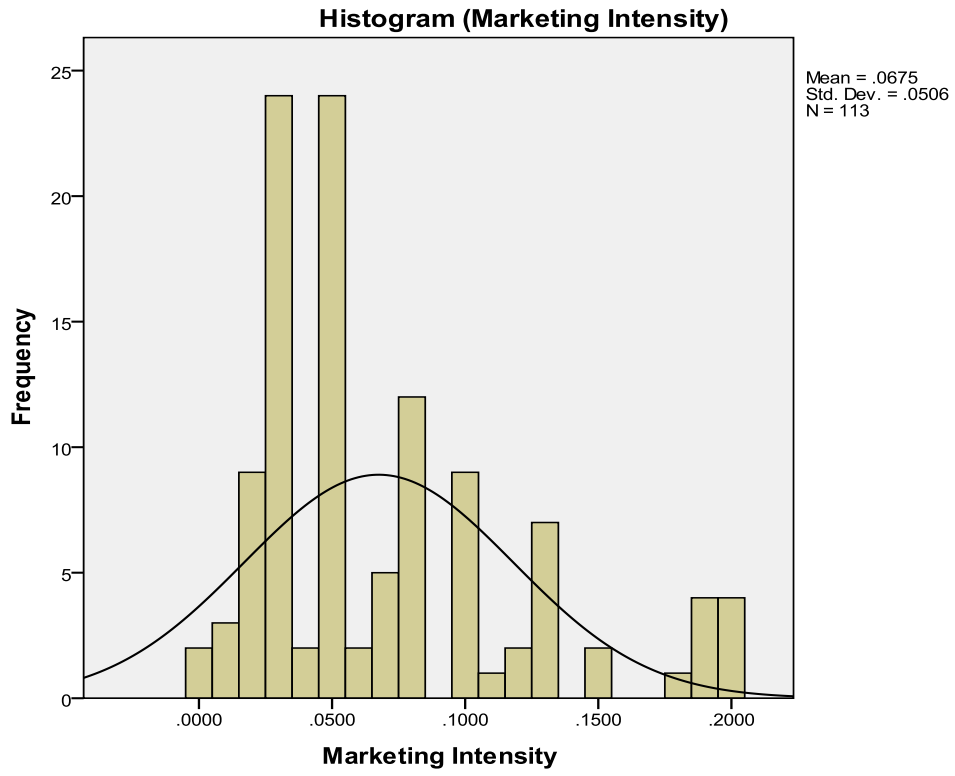

Normal Q-Q Plot of Firm Age (Years)
Expected Normal
Observed Value

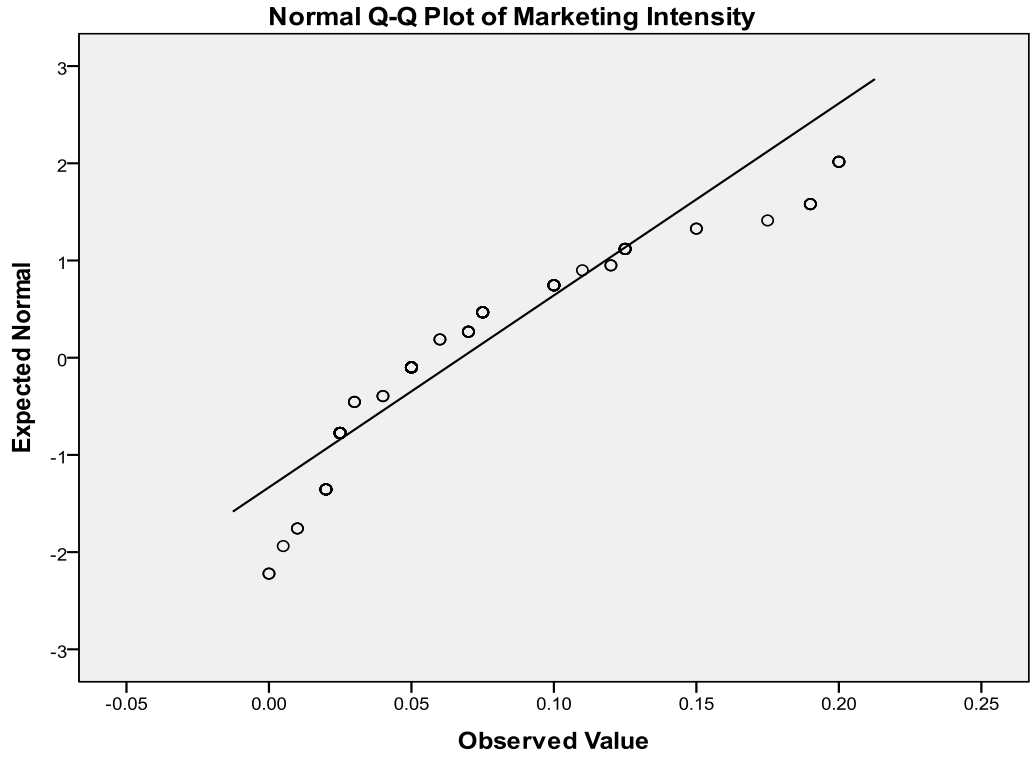

Detrended Normal Q-Q Plot of Firm Age (Years)
Dev from Normal
Observed Value

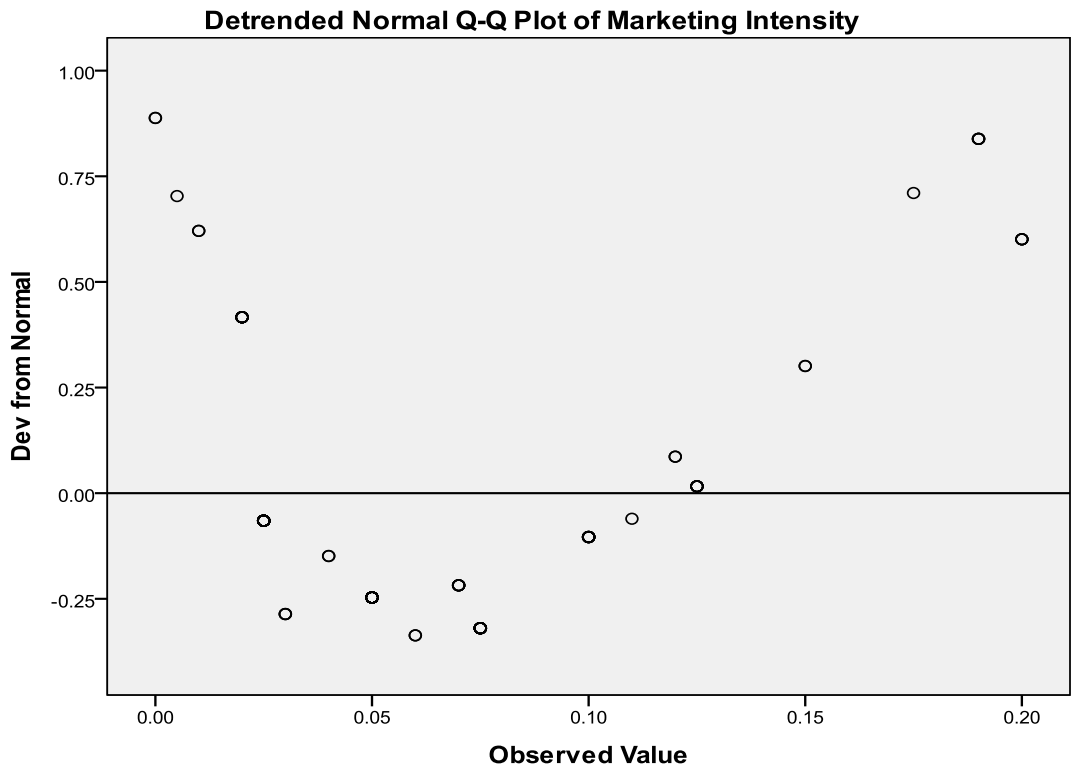

Histogram (R&D Intensity)
Mean = .1596
Std. Dev. = .1395
N = 113
Frequency
R&D Intensity
0
10
20
30
40
.0000
.1000
.2000
.3000
.4000
.5000

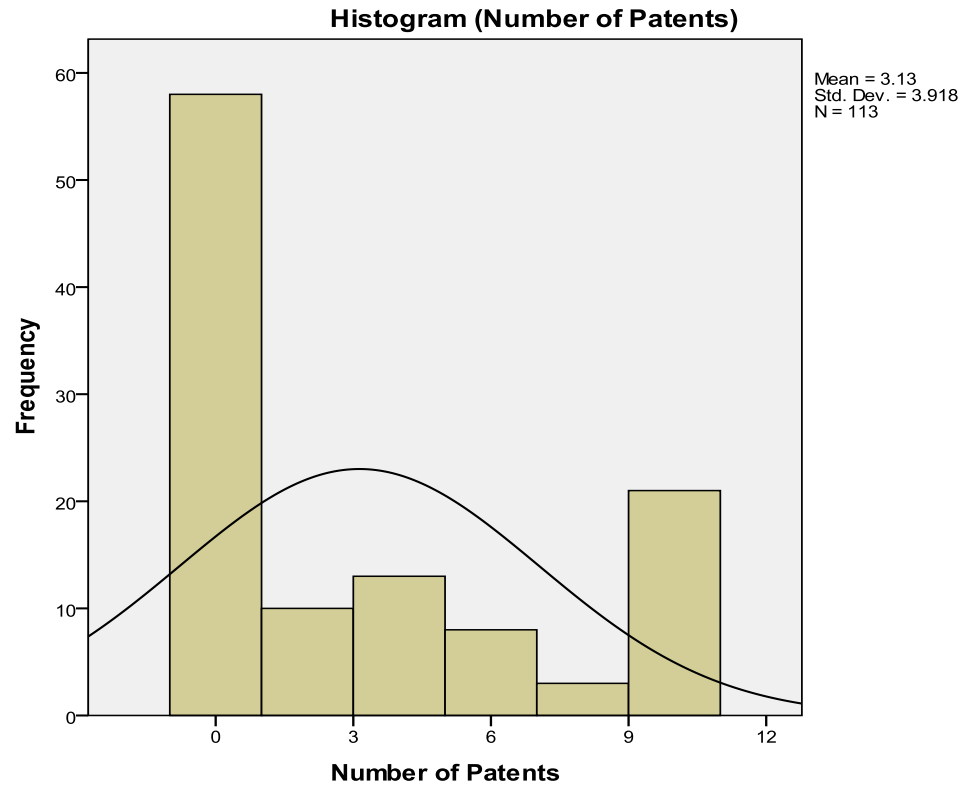

Normal Q-Q Plot of R&D Intensity
Expected Normal
Observed Value
3
2
1
0
-1
-2
-3
-0.1
0.0
0.1
0.2
0.3
0.4
0.5

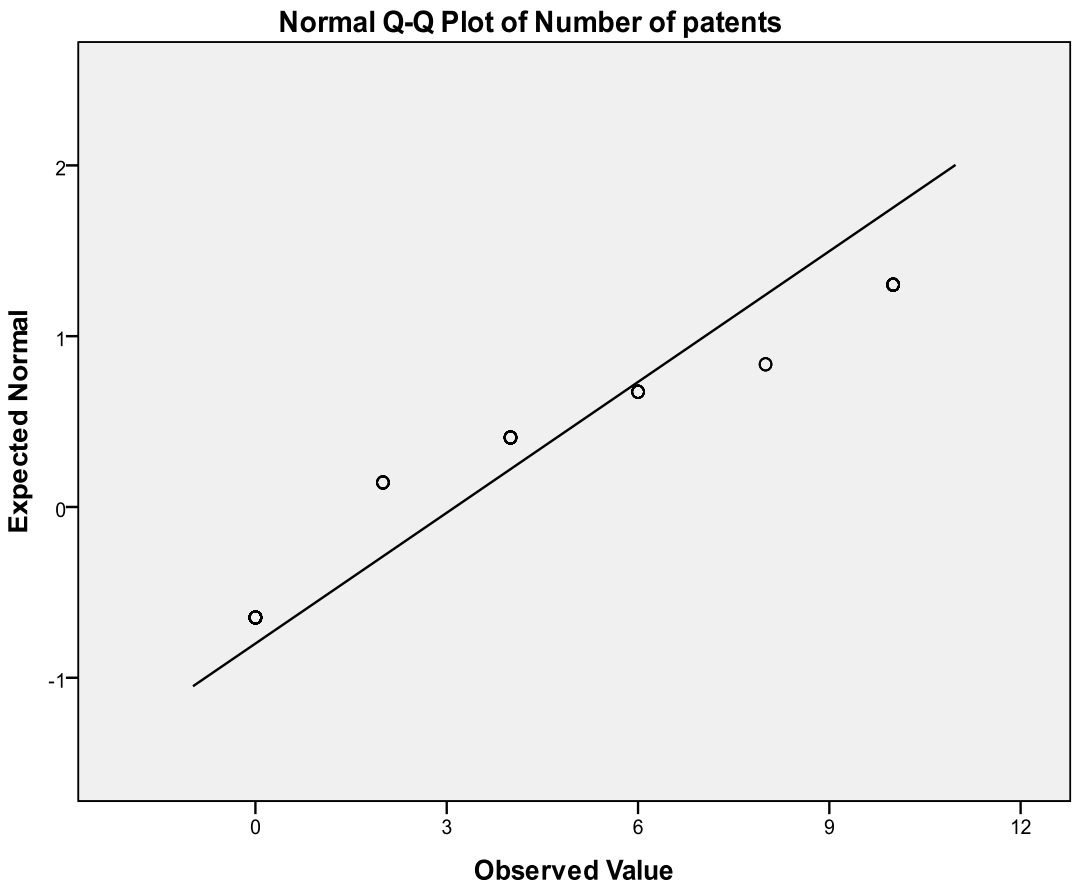

Detrended Normal Q-Q Plot of R&D Intensity
Dev from Normal
Observed Value
1.0
0.8
0.6
0.4
0.2
0.0000
-0.2
-0.4
0.0
0.1
0.2
0.3
0.4
0.5

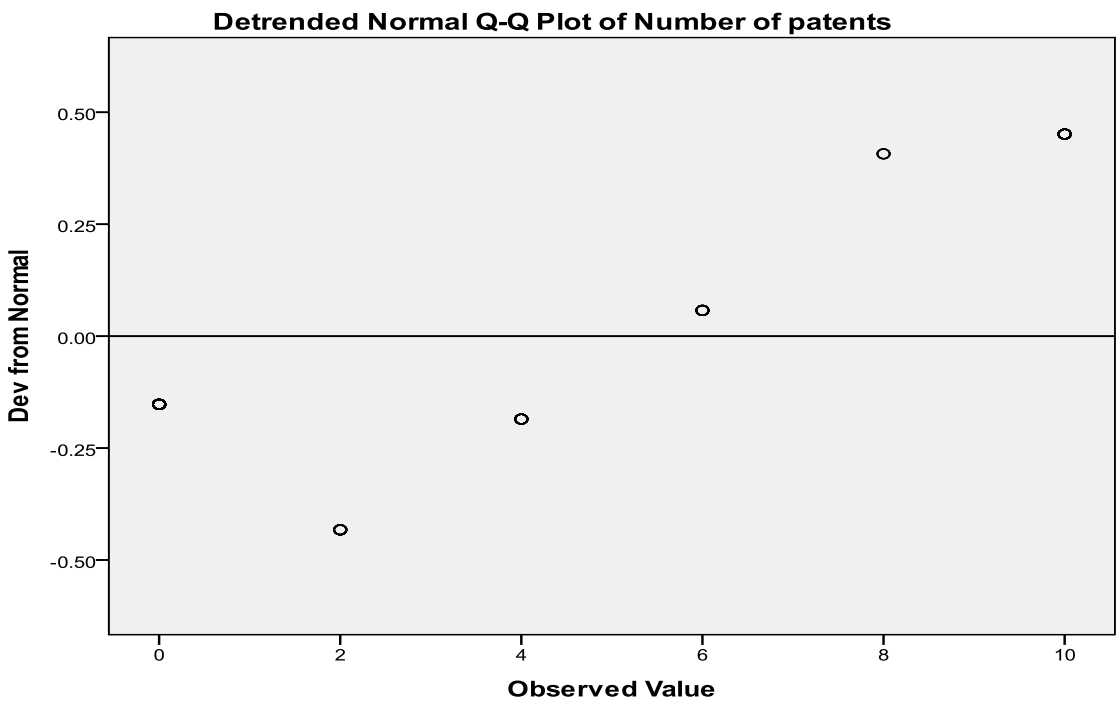

Histogram (Marketing Intensity)
Mean = .0675
Std. Dev. = .0506
N = 113
Frequency
25
20
15
10
5
0
.0000
.0500
.1000
.1500
.2000
Marketing Intensity

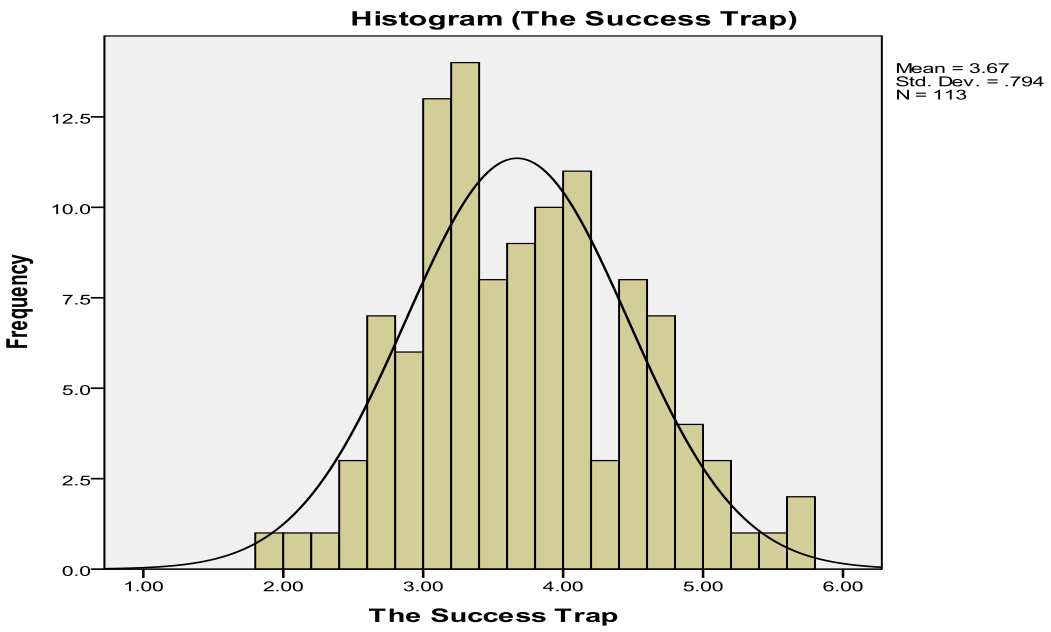

Normal Q-Q Plot of Marketing Intensity
Expected Normal
3
2
1
0
-1
-2
-3
-0.05
0.00
0.05
0.10
0.15
0.20
0.25
Observed Value

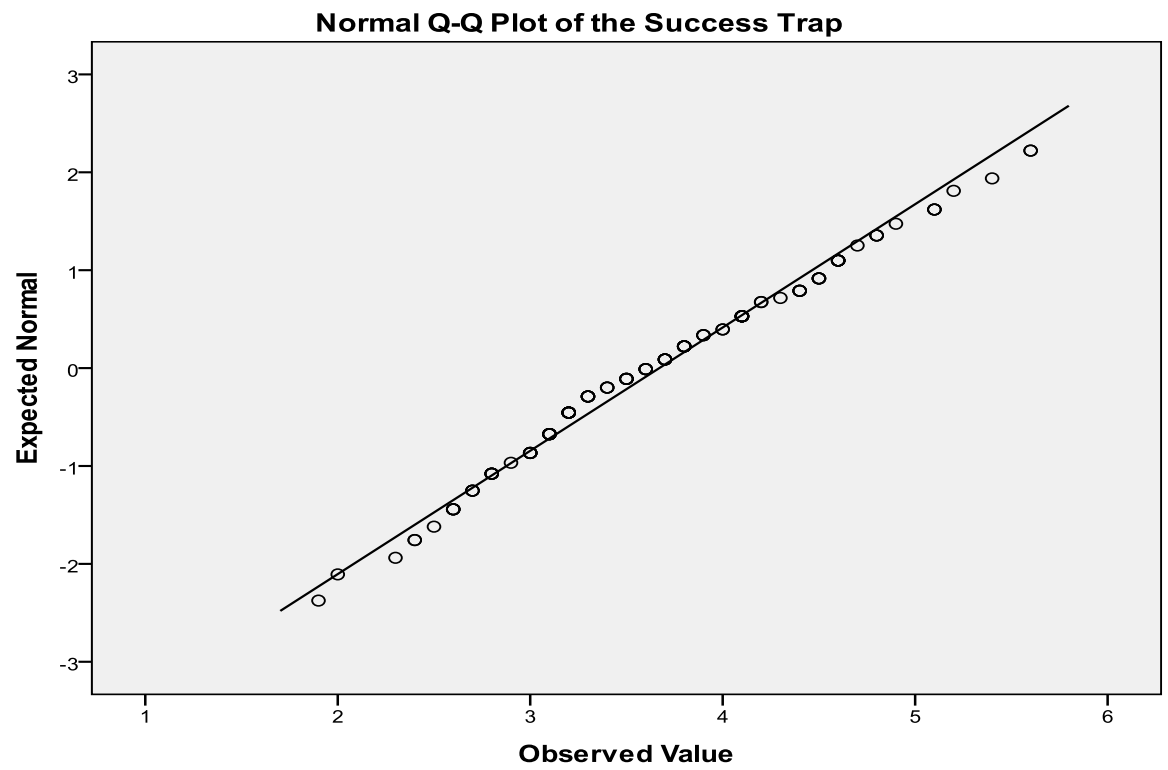

Detrended Normal Q-Q Plot of Marketing Intensity
Dev from Normal
1.00
0.75
0.50
0.25
0.00
-0.25
0.00
0.05
0.10
0.15
0.20
Observed Value

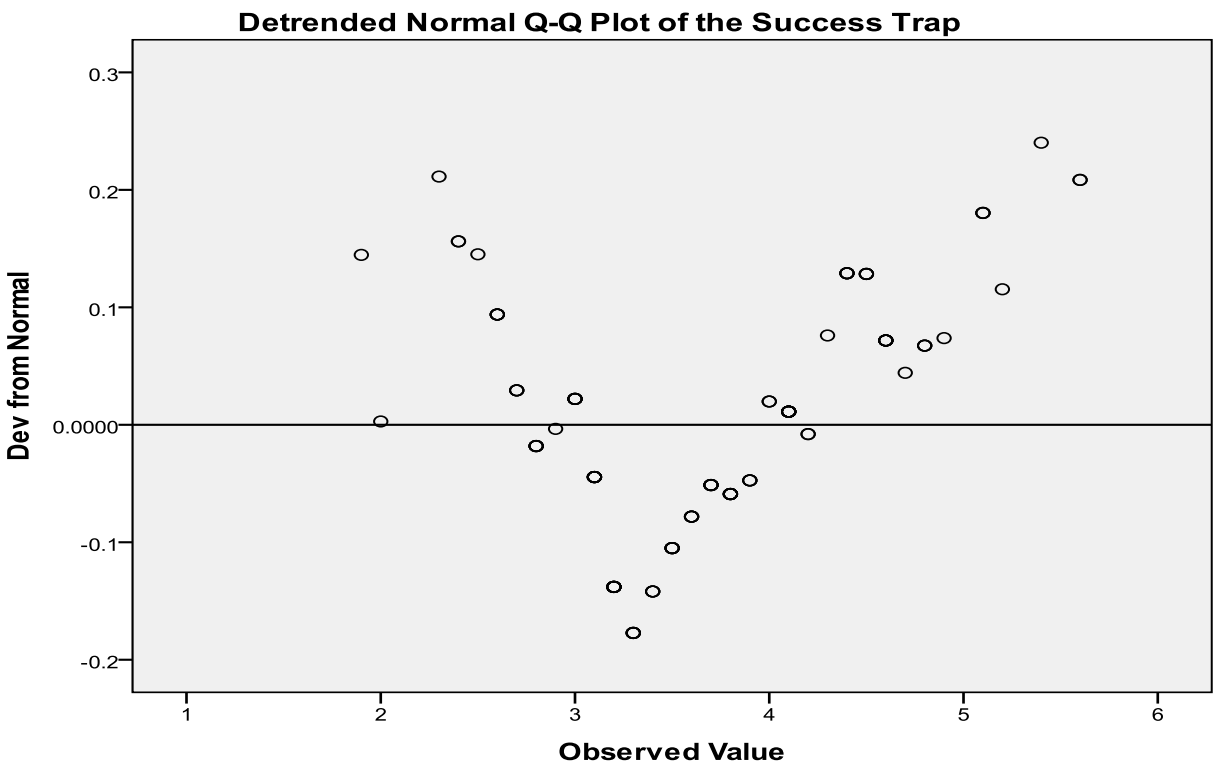

Histogram (Number of Patents)
Mean = 3.13
Std. Dev. = 3.918
N = 113
Frequency
Number of Patents

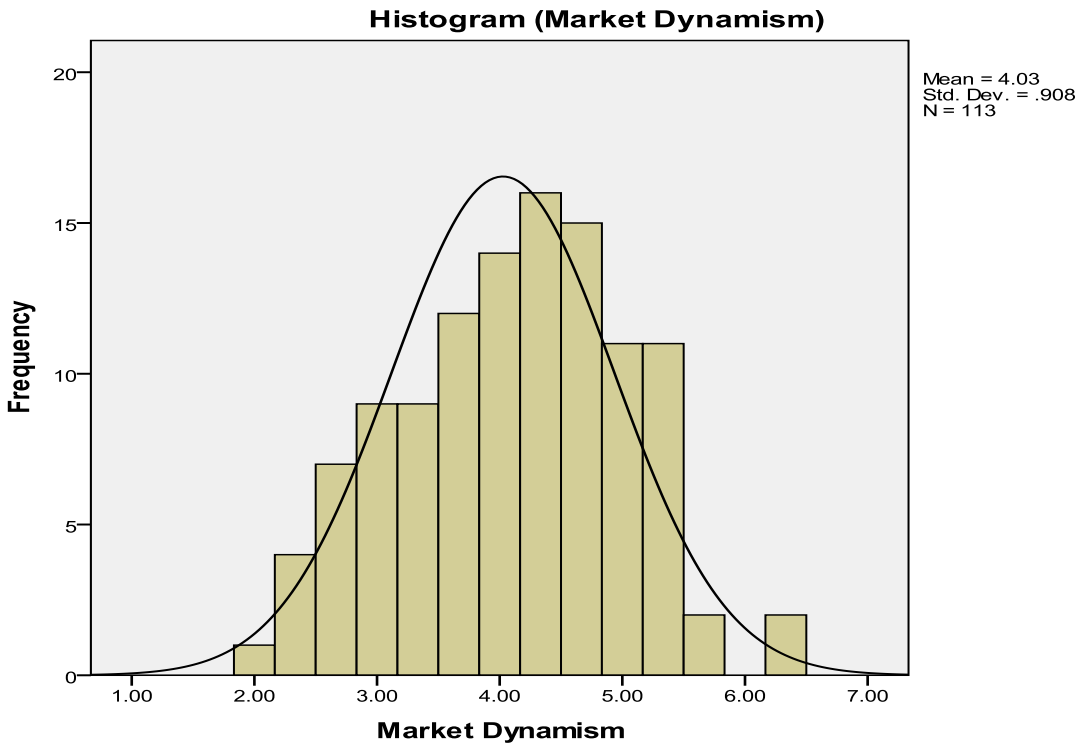

Normal Q-Q Plot of Number of patents
Expected Normal
Observed Value

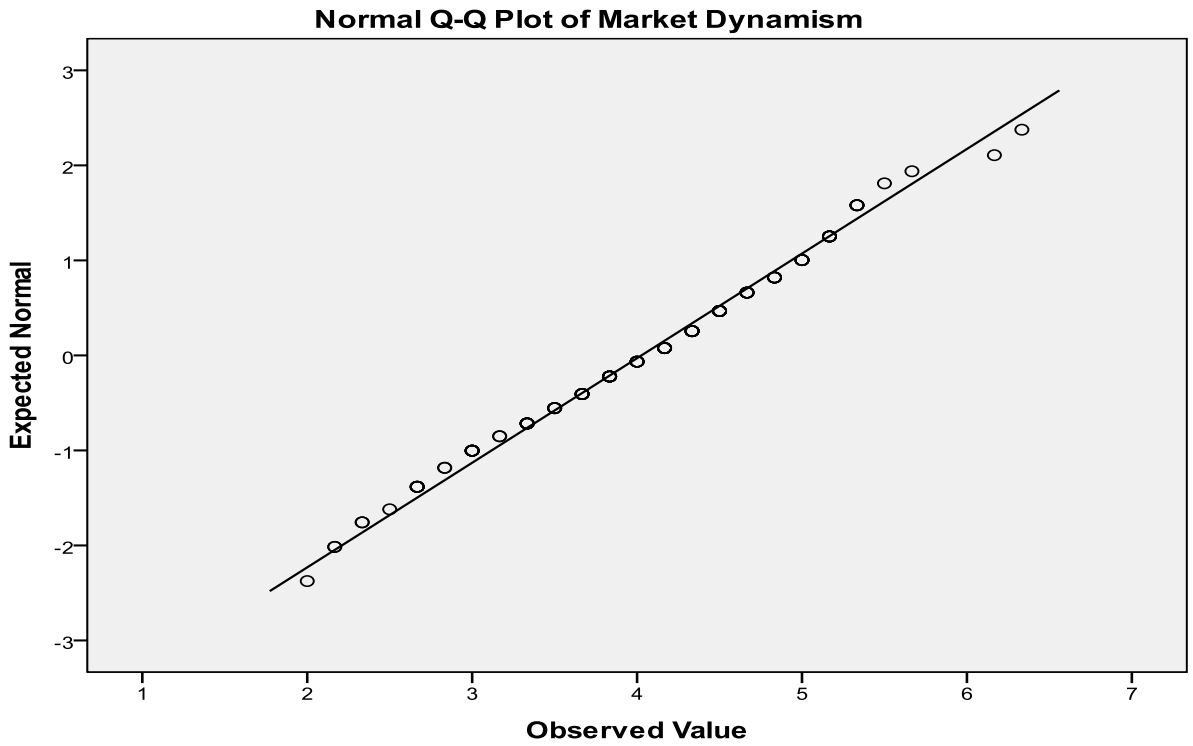

Detrended Normal Q-Q Plot of Number of patents
Dev from Normal
Observed Value

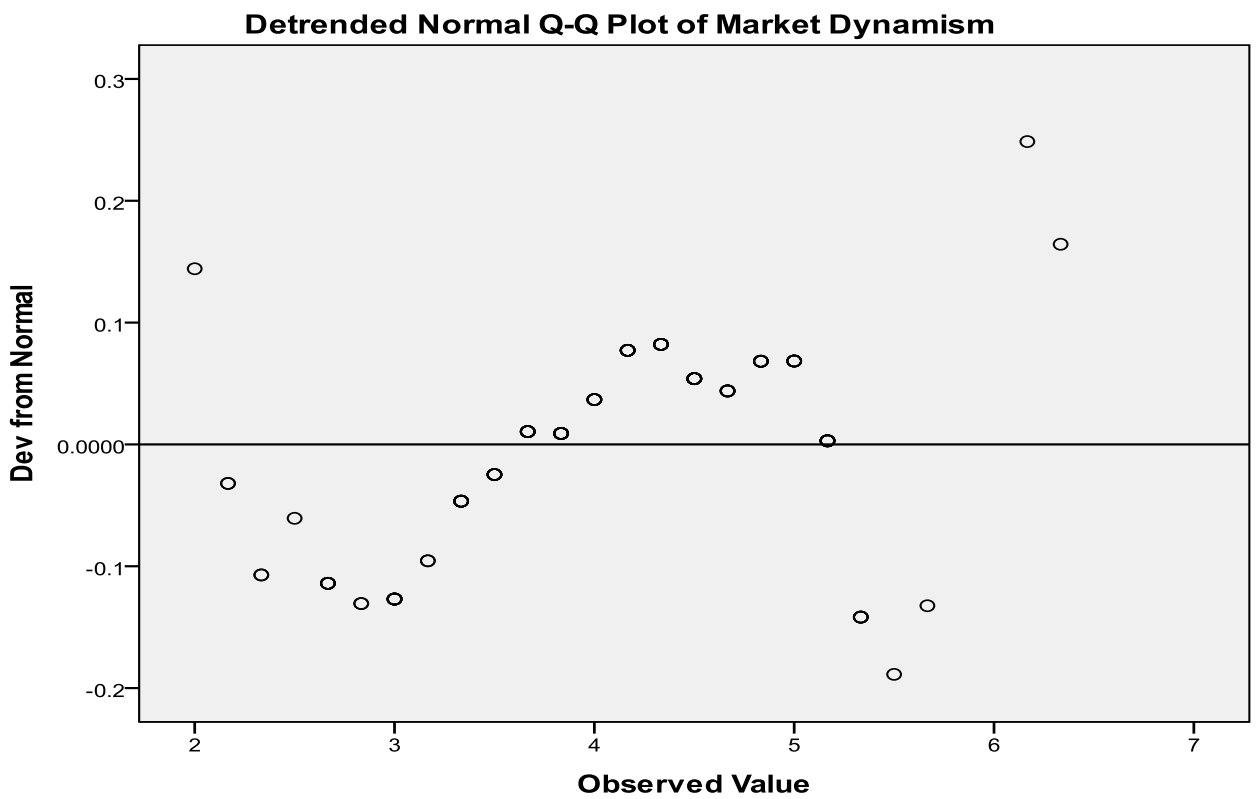

Histogram (The Success Trap)
Mean = 3.67
Std. Dev. = .794
N = 113
Frequency
12.5
10.0
7.5
5.0
2.5
0.0
1.00
2.00
3.00
4.00
5.00
6.00
The Success Trap

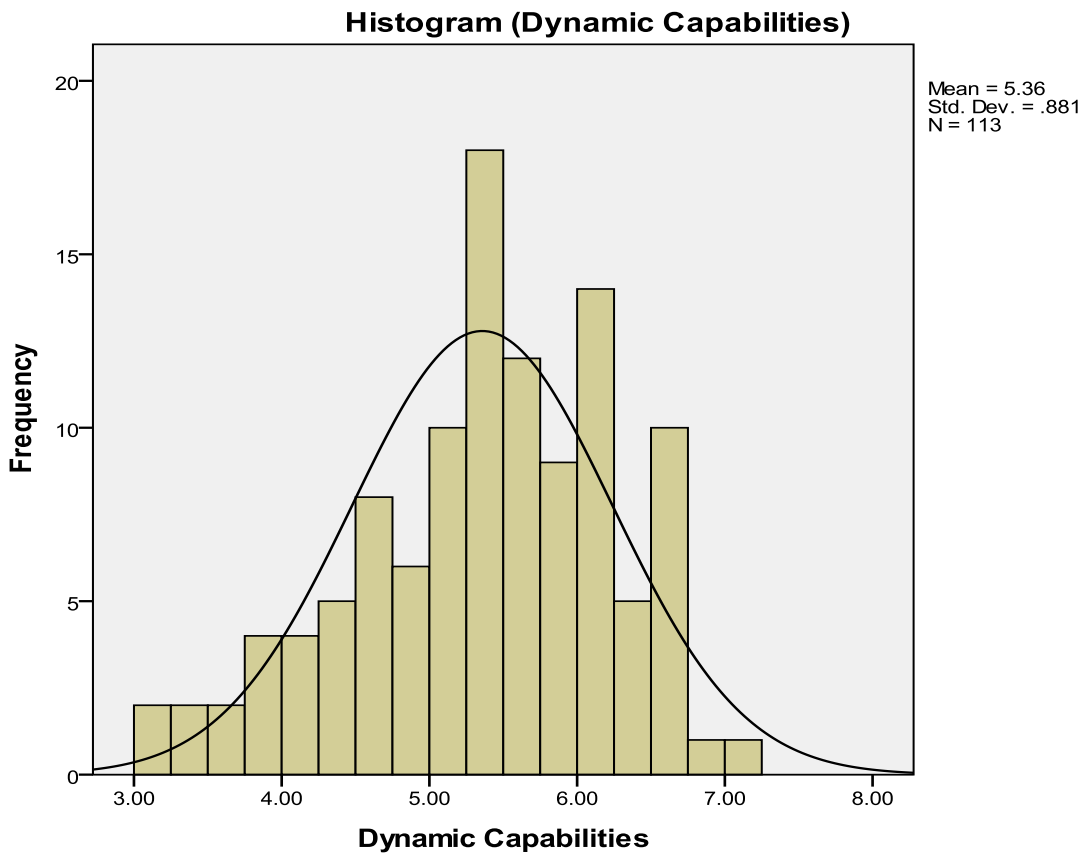

Normal Q-Q Plot of the Success Trap
Expected Normal
3
2
1
0
-1
-2
-3
1
2
3
4
5
6
Observed Value

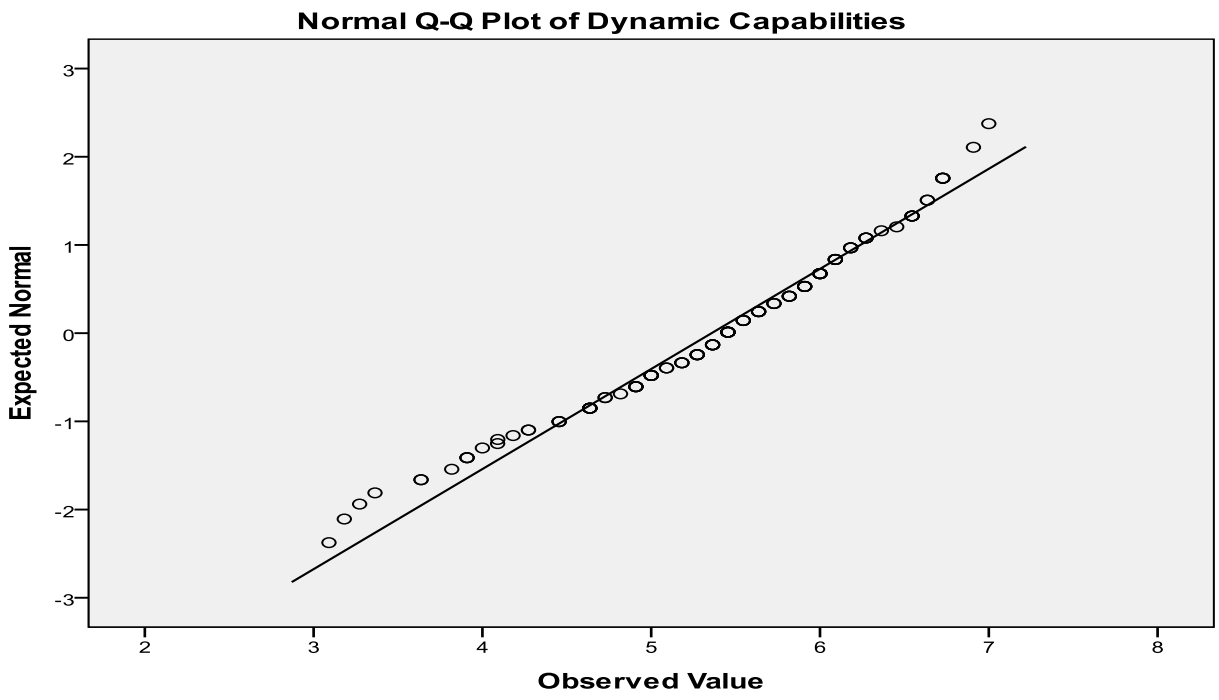

Detrended Normal Q-Q Plot of the Success Trap
Dev from Normal
0.3
0.2
0.1
0.0000
-0.1
-0.2
1
2
3
4
5
6
Observed Value

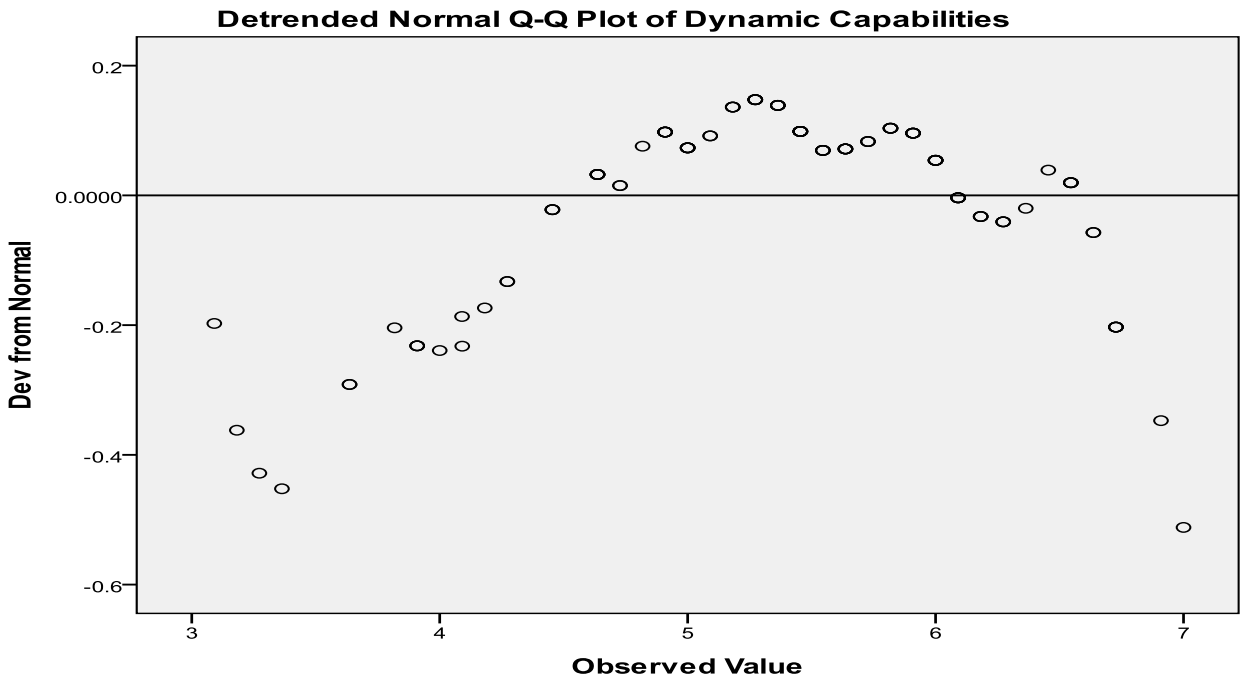

Histogram (Market Dynamism)
Mean = 4.03
Std. Dev. = .908
N = 113
Frequency
Market Dynamism

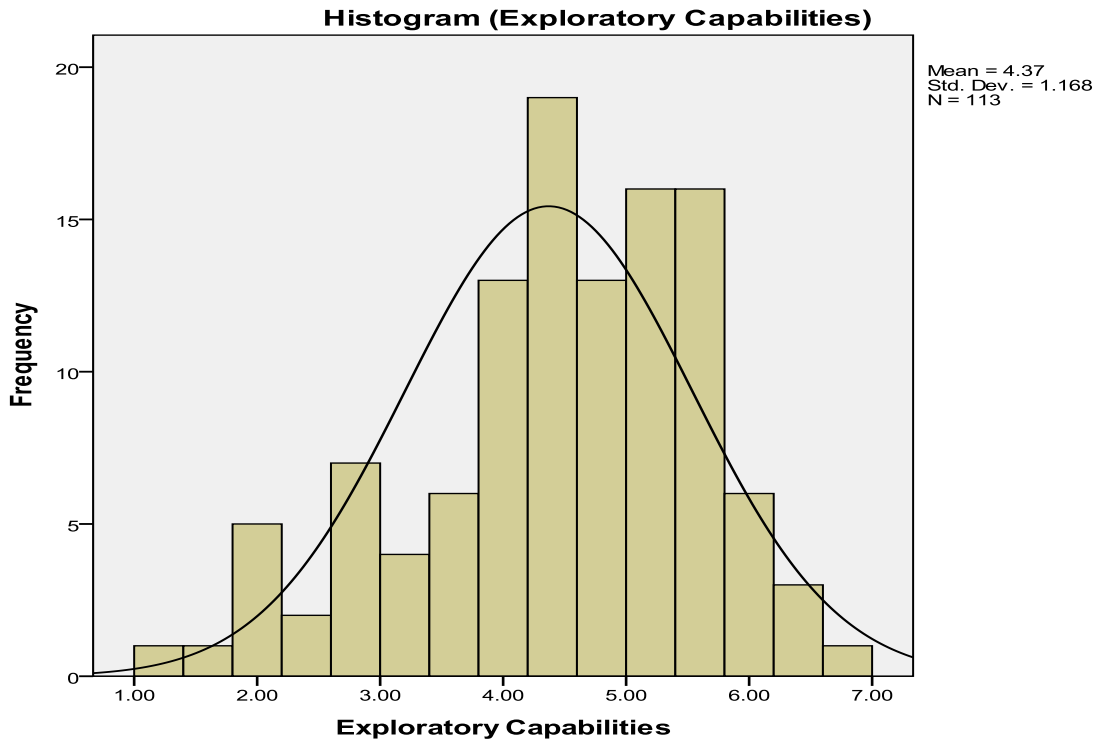

Normal Q-Q Plot of Market Dynamism
Expected Normal
Observed Value

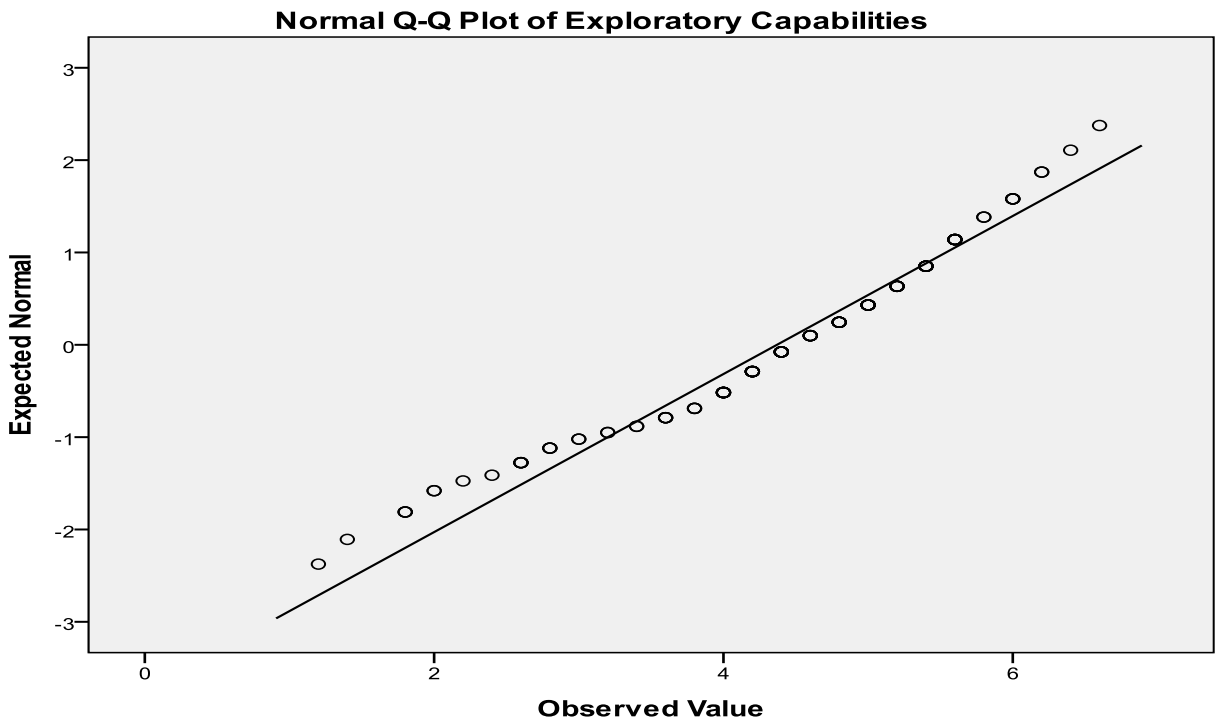

Detrended Normal Q-Q Plot of Market Dynamism
Dev from Normal
Observed Value

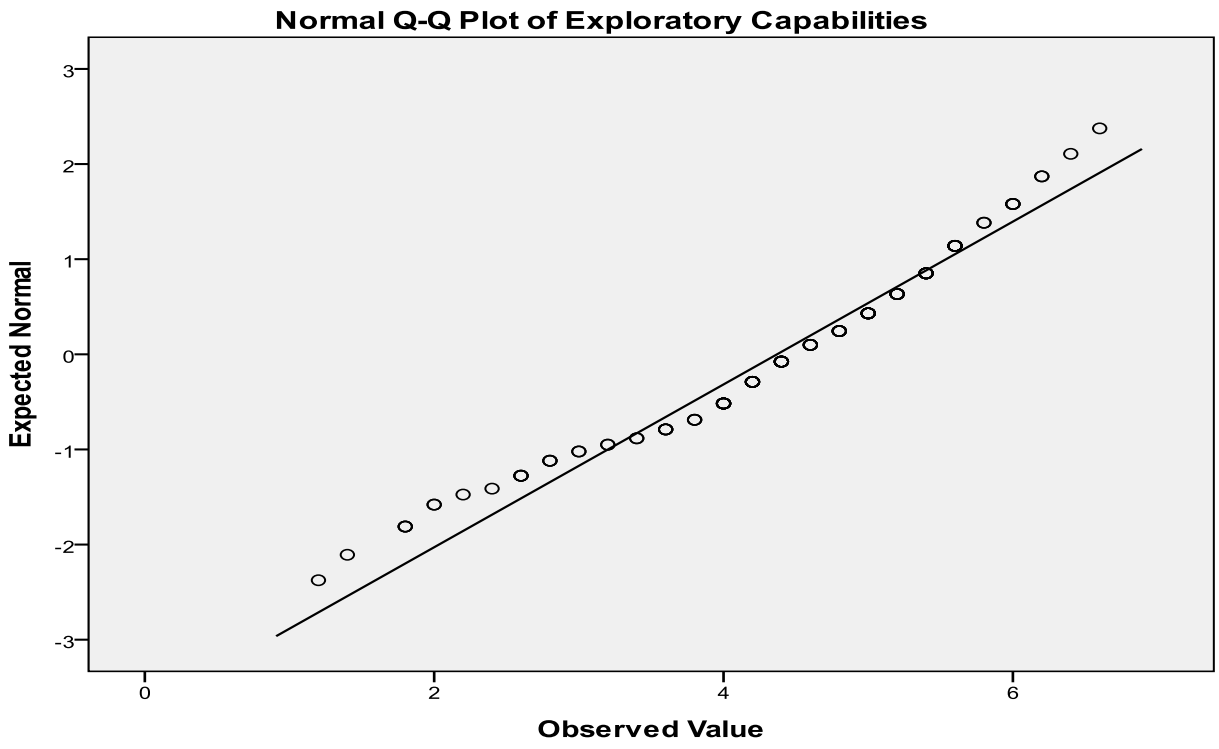

Histogram (Dynamic Capabilities)
Mean = 5.36
Std. Dev. = .881
N = 113
Frequency
Dynamic Capabilities

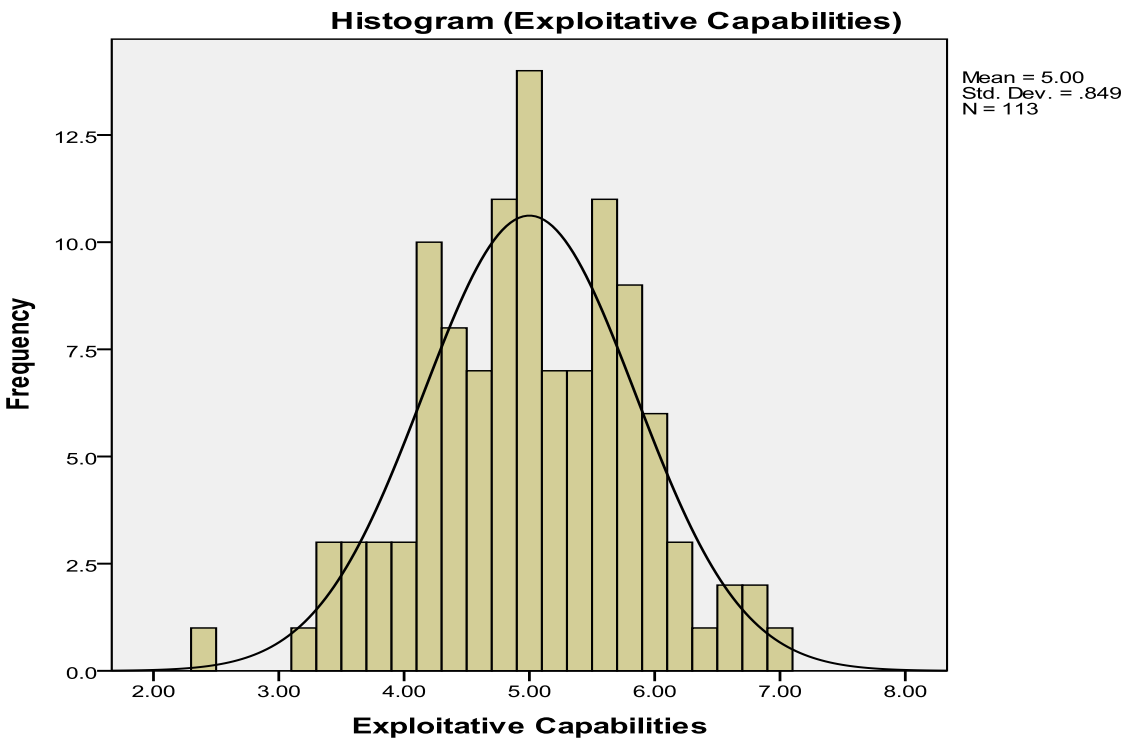

Normal Q-Q Plot of Dynamic Capabilities
Expected Normal
Observed Value

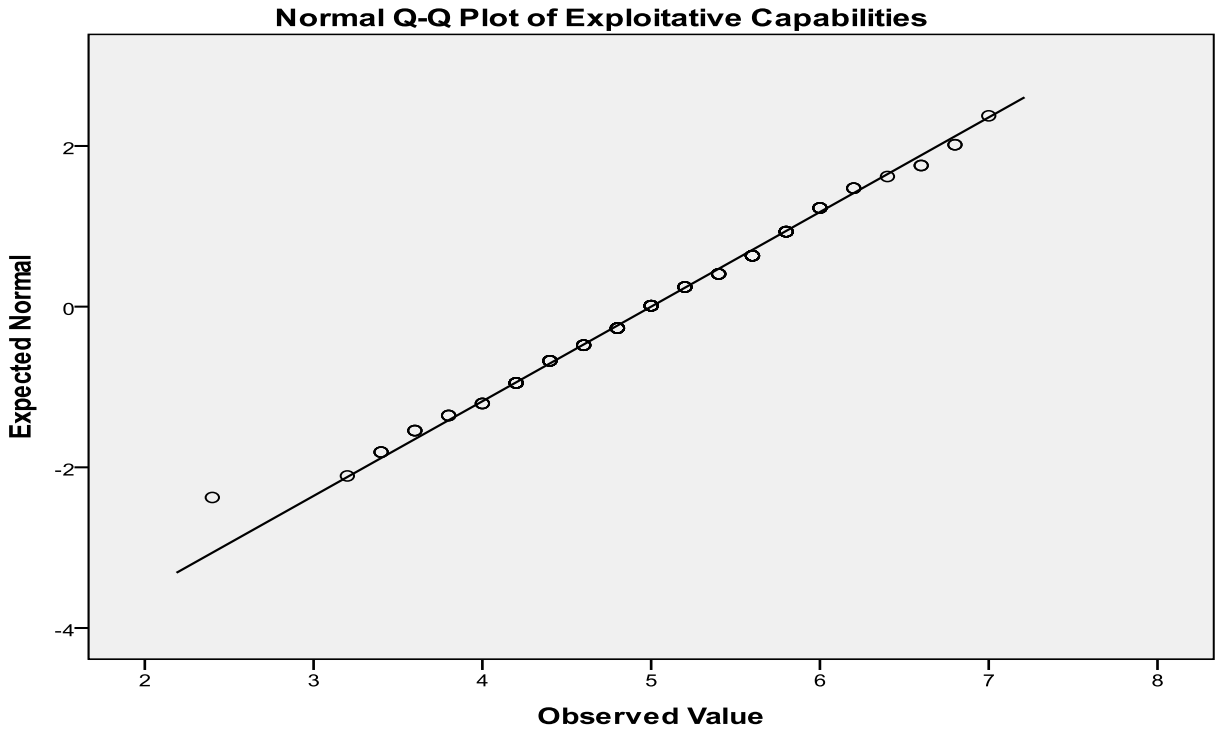

Detrended Normal Q-Q Plot of Dynamic Capabilities
Dev from Normal
Observed Value

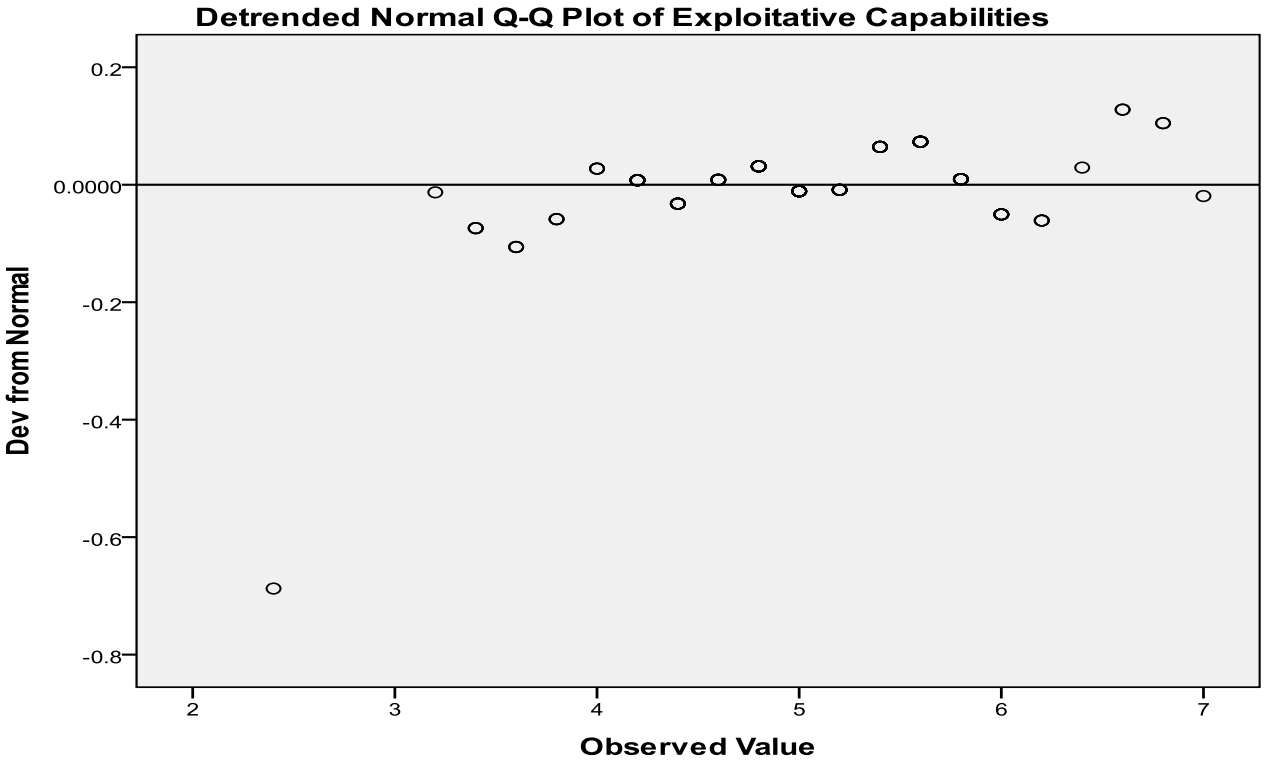

Histogram (Exploratory Capabilities)
Mean = 4.37
Std. Dev. = 1.168
N = 113
Frequency
Exploratory Capabilities

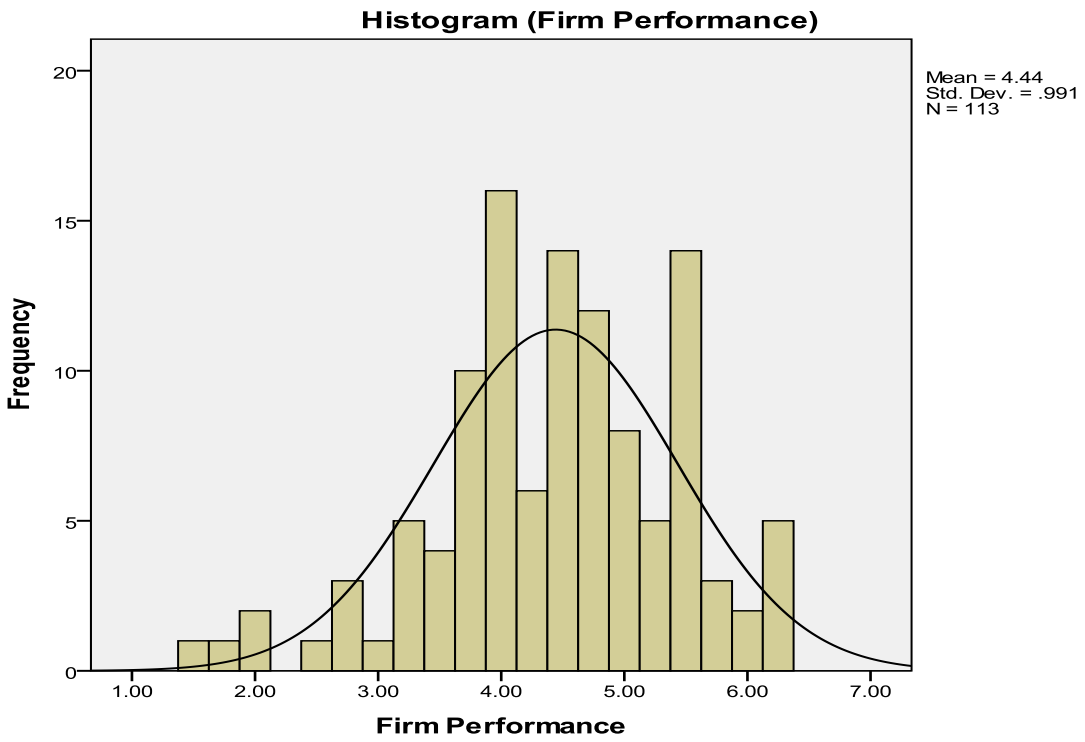

Normal Q-Q Plot of Exploratory Capabilities
Expected Normal
Observed Value

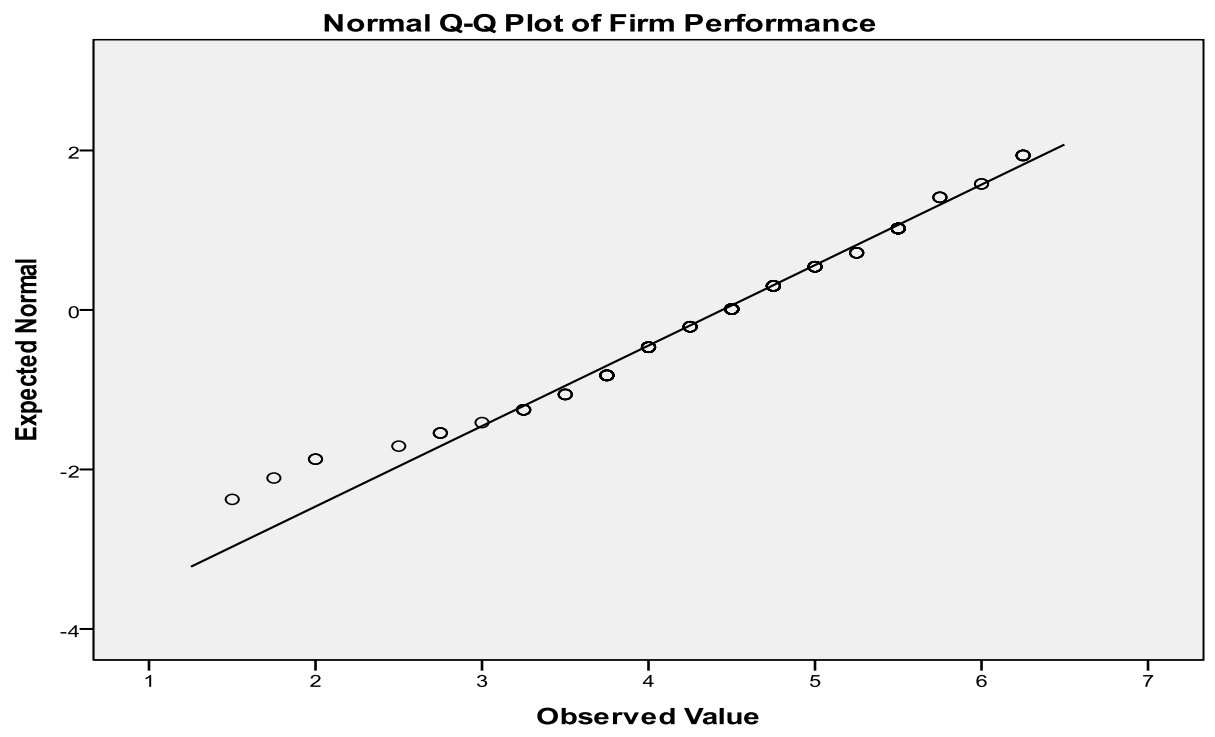

Normal Q-Q Plot of Exploratory Capabilities
Expected Normal
Observed Value

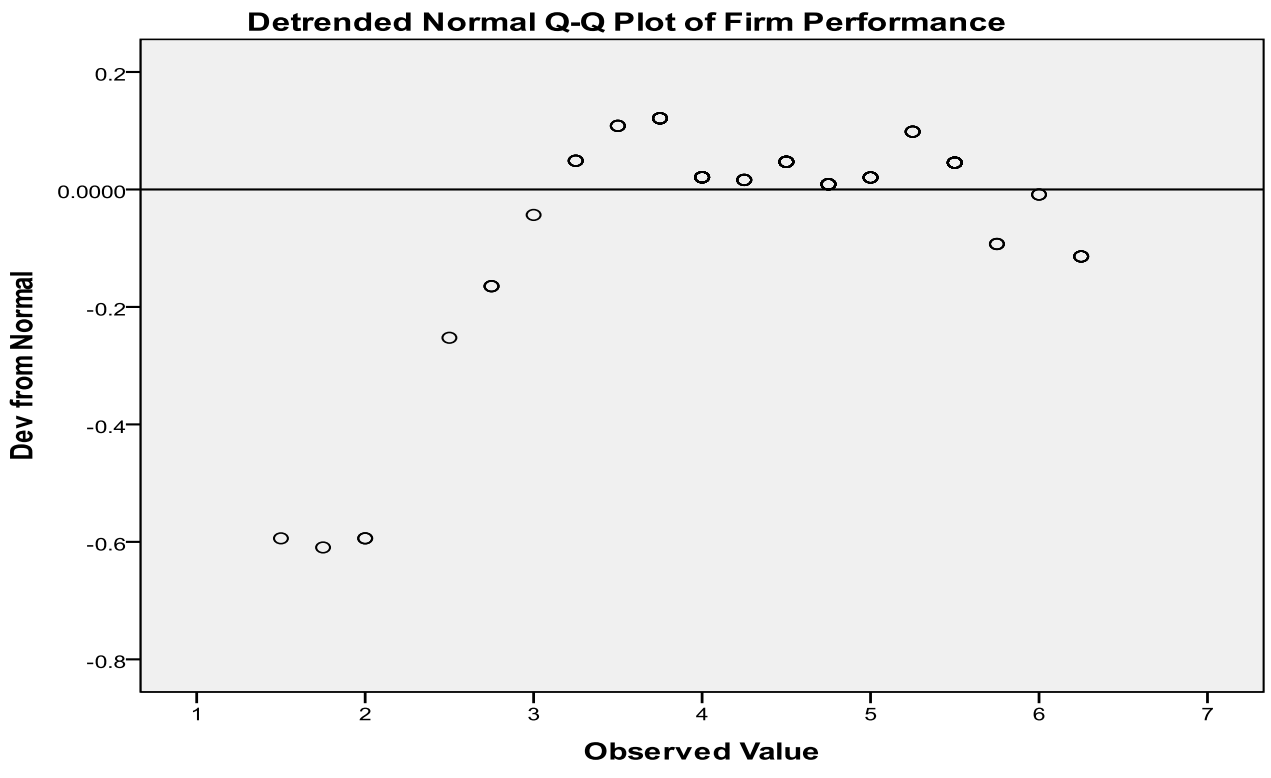

Histogram (Exploitative Capabilities)
Mean = 5.00
Std. Dev. = .849
N = 113
Frequency
0.0
2.5
5.0
7.5
10.0
12.5
2.00
3.00
4.00
5.00
6.00
7.00
8.00
Exploitative Capabilities


Normal Q-Q Plot of Exploitative Capabilities
Expected Normal
2
0
-2
-4
2
3
4
5
6
7
8
Observed Value


Detrended Normal Q-Q Plot of Exploitative Capabilities
Dev from Normal
0.2
0.0000
-0.2
-0.4
-0.6
-0.8
2
3
4
5
6
7
Observed Value


Histogram (Firm Performance)
Mean = 4.44
Std. Dev. = .991
N = 113
Frequency
Firm Performance


Normal Q-Q Plot of Firm Performance
Expected Normal
Observed Value


Detrended Normal Q-Q Plot of Firm Performance
Dev from Normal
Observed Value

2. Test of Normality (Statistical Methods)

Skewness and Kurtosis Test

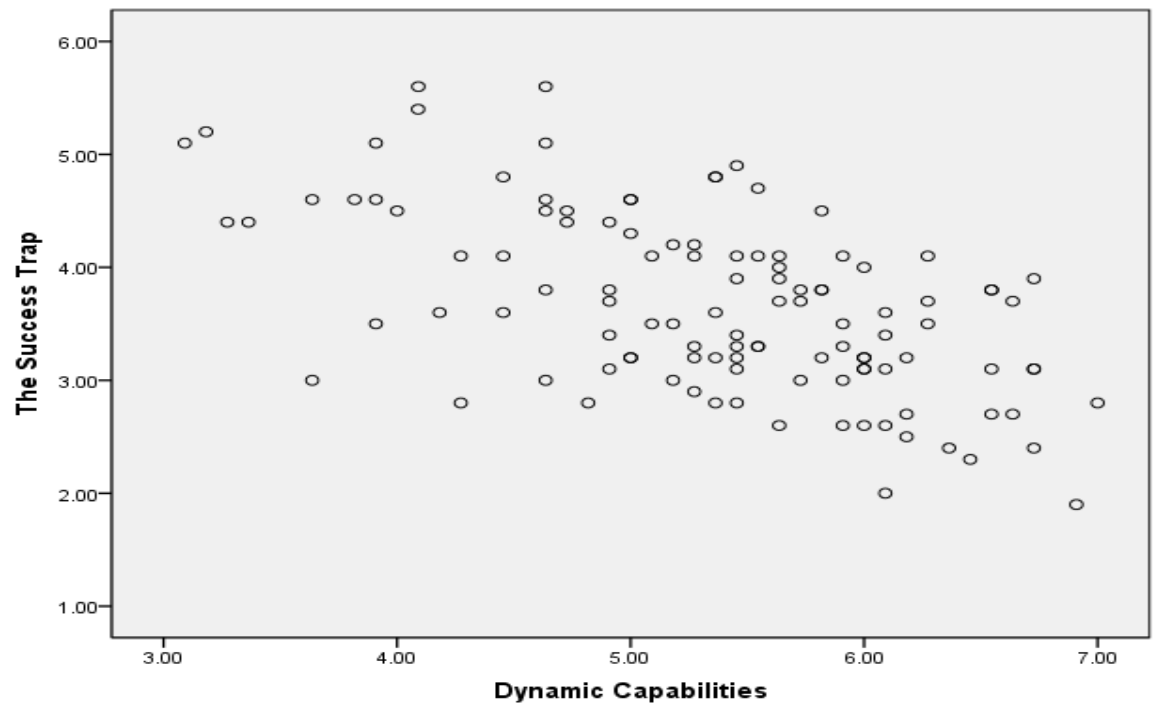
	Firm Size	Firm Age	R&D Intensity	Marketing Intensity	No. of Patents	DCs	Exploratory Capabilities	Exploitative Capabilities	The Success Trap	Market Dynamism	Firm Performance
(A)Skewness	1.318	0.927	0.875	1.181	0.838	-0.503	-0.655	-0.152	0.272	-0.071	-0.475
(B)Std Error for Skewness	0.227	0.227	0.227	0.227	0.227	0.227	0.227	0.227	0.227	0.227	0.227
(C)Kurtosis	0.877	0.148	-0.66	1.476	-0.901	-0.16	0.026	0.063	-0.405	-0.434	0.36
(D)Std Error for Kurtosis	0.451	0.451	0.451	0.738	0.451	0.451	0.451	0.451	0.451	0.451	0.451
Z-Scores for Skewness Test (A/B)	5.806167401	4.083700441	3.8546256	5.202643172	3.691629956	-2.21586	-2.88546	-0.6696	1.198238	-0.31278	-2.09251
Z-Scores for Kurtosis Test (C/D)	1.944567627	0.328159645	-1.463415	2	-1.997782705	-0.35477	0.05765	0.13969	-0.898	-0.96231	0.798226

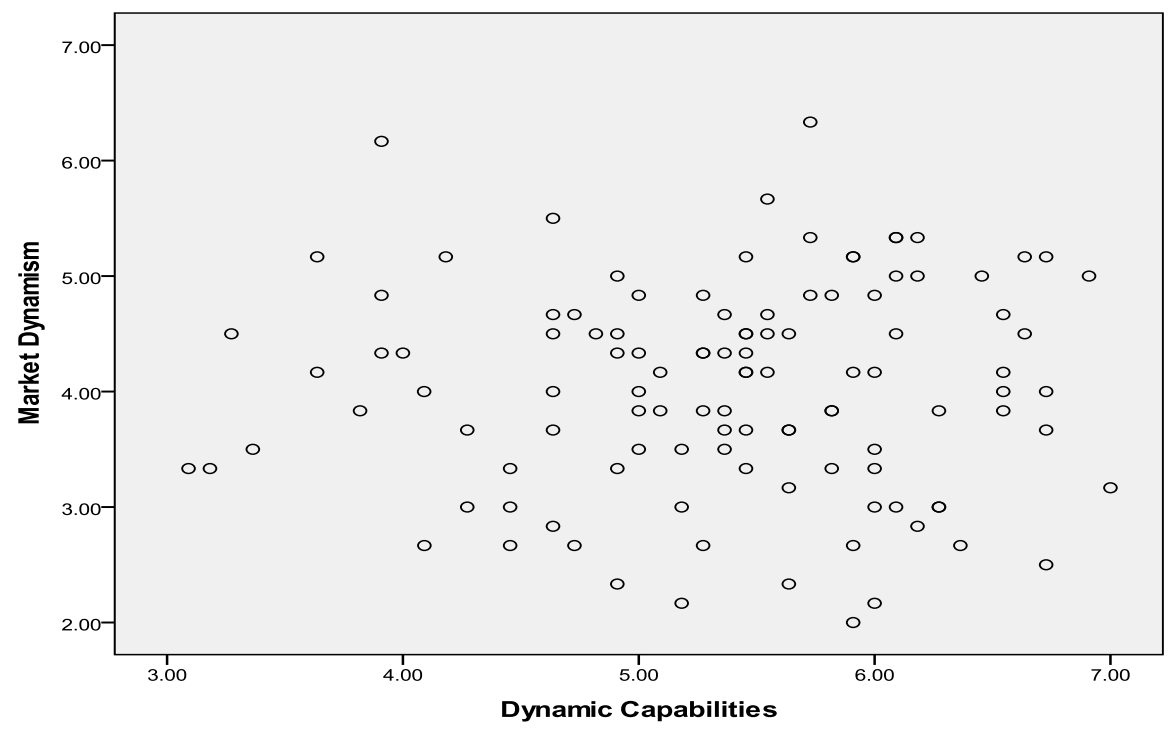
Kolmogorov-Smirnov Test of Normality

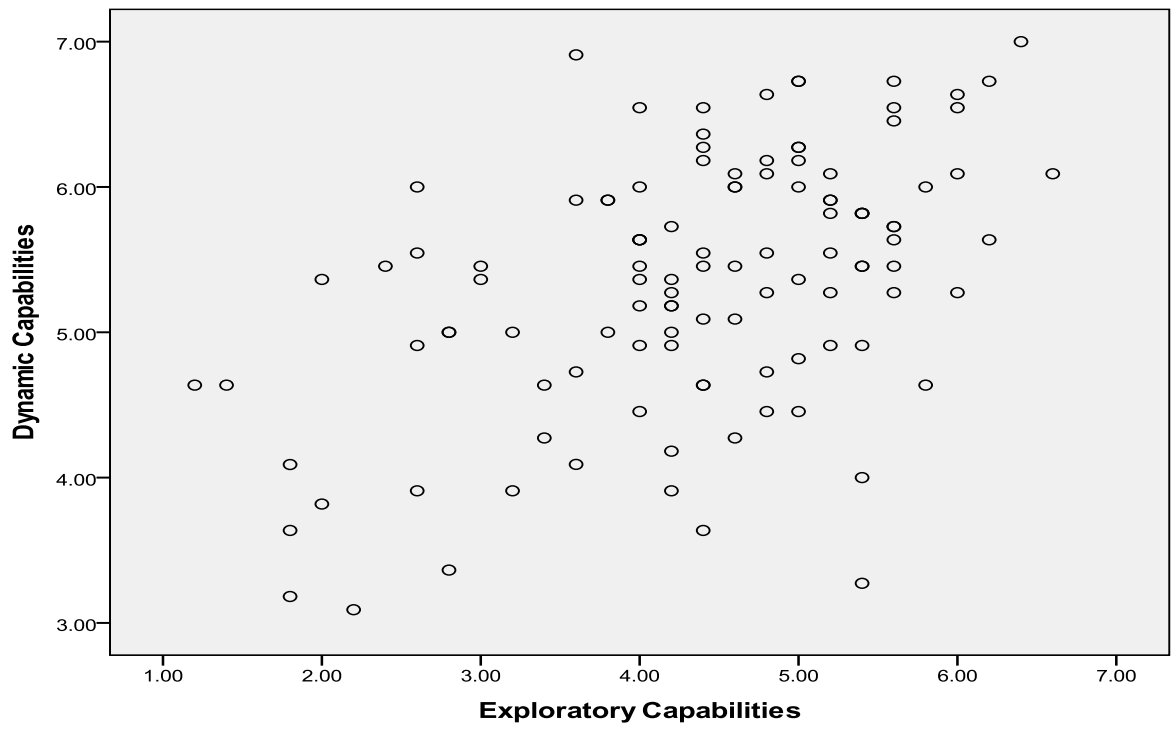
	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
Firm Size	.298	113	.000
Firm Age	.131	113	.000
R & D Intensity	.179	113	.000
Marketing Intensity	.202	113	.000
Number of Patents	.301	113	.000
Dynamic Capabilities	.081	113	**.066**
Exploratory Capabilities	.119	113	.000
Exploitative Capabilities	.070	113	**.200**
The Success Trap	.087	113	.036
Market Dynamism	.066	113	**.200**
Firm Performance	.083	113	**.053**

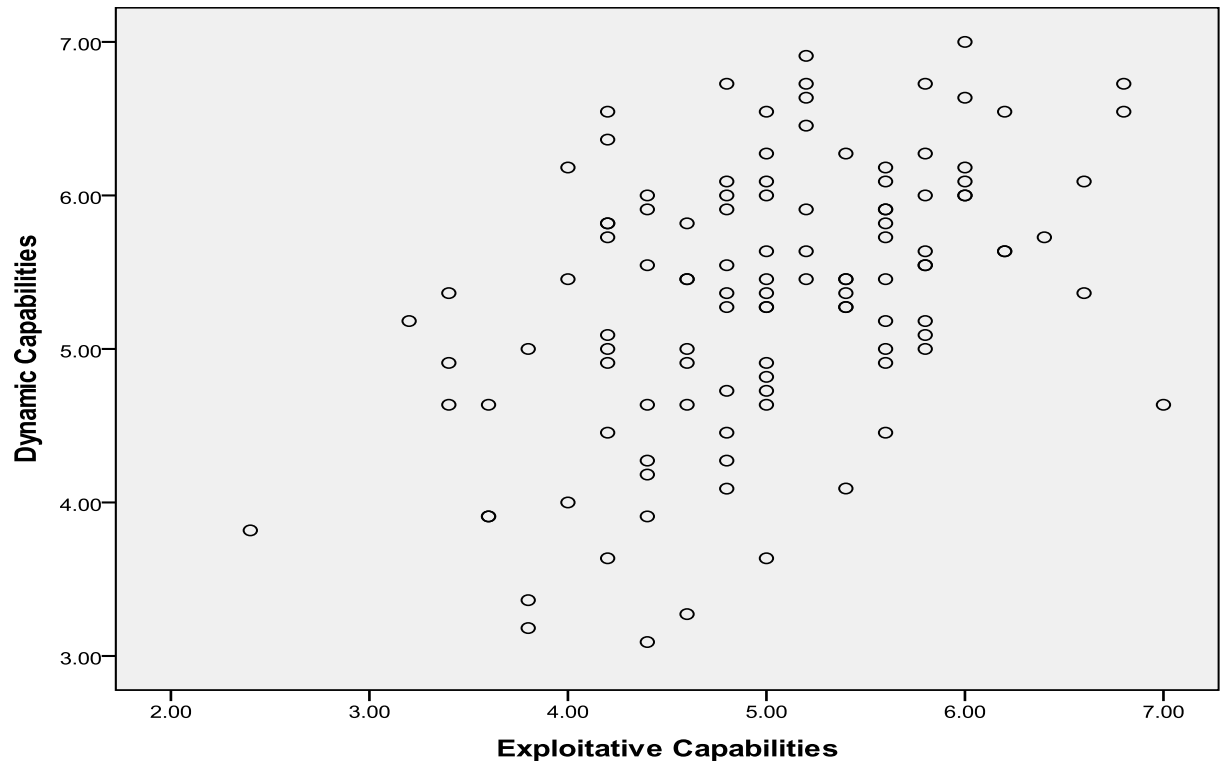
a. Lilliefors Significance Correction

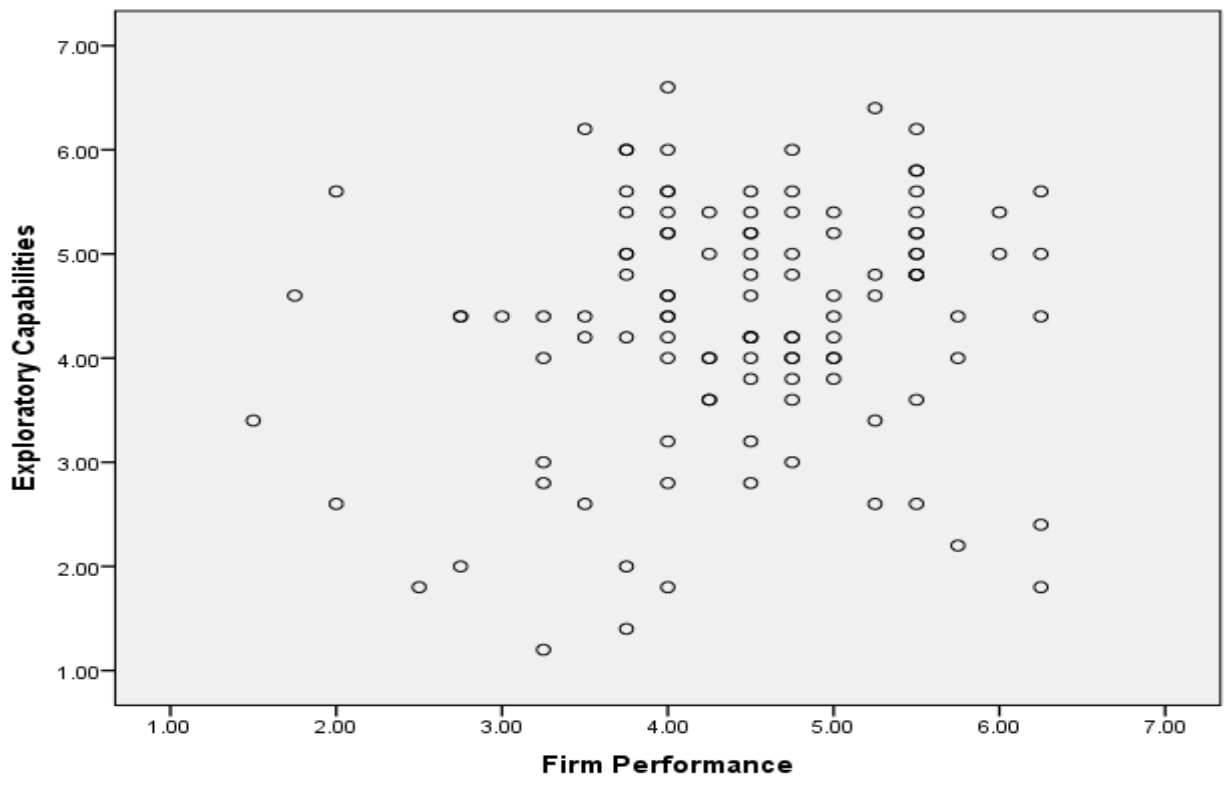
3. Test of Homoscedasticiy (Scatter Plots)

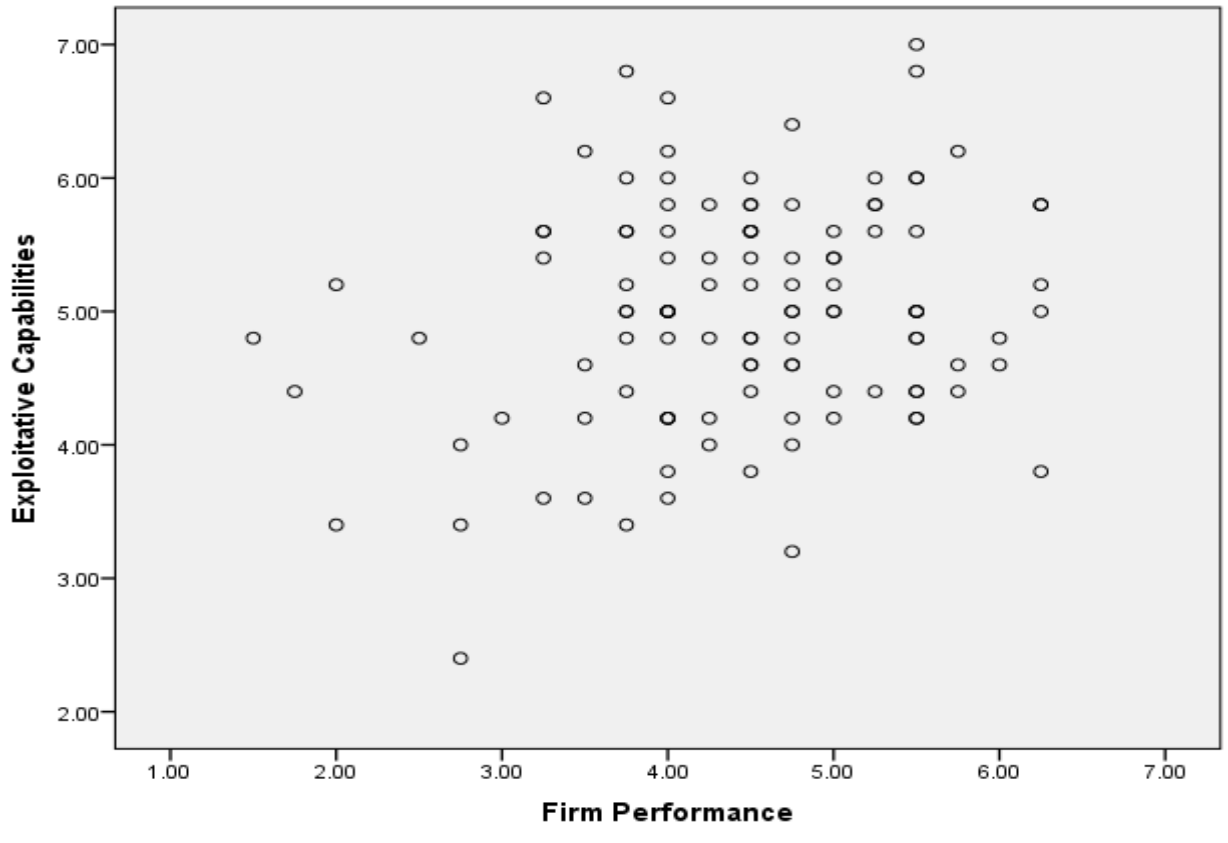







Dynamic Capabilities
7.00
6.00
5.00
4.00
3.00
2.00
3.00
4.00
5.00
6.00
7.00
Exploitative Capabilities


Exploratory Capabilities
7.00
6.00
5.00
4.00
3.00
2.00
1.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
Firm Performance


Exploitative Capabilities
7.00
6.00
5.00
4.00
3.00
2.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
Firm Performance

4. Testing Multicollinearity (Correlations Matrix)

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) Firm Size	Pearson Correlation	1										
	Sig. (2-tailed)											
(2) Firm Age	Pearson Correlation	0.54**	1									
	Sig. (2-tailed)	0.00										
(3) R&D Intensity	Pearson Correlation	-0.28**	-0.40**	1								
	Sig. (2-tailed)	0.00	0.00									
(4) Marketing Intensity	Pearson Correlation	-0.23*	-0.27**	0.44*	1							
	Sig. (2-tailed)	0.02	0.00	0.00								
(5) Number of Patents	Pearson Correlation	0.18	-0.01	0.39**	0.23*	1						
	Sig. (2-tailed)	0.06	0.89	0.00	0.02							
(6) Dynamic Capabilities	Pearson Correlation	-0.17	-0.23*	0.28**	0.12	0.10	1					
	Sig. (2-tailed)	0.07	0.01	0.00	0.22	0.30						
(7) Exploratory Capabilities	Pearson Correlation	0.13	0.07	0.21*	0.06	0.29**	0.50**	1				
	Sig. (2-tailed)	0.16	0.45	0.02	0.56	0.00	0.00					
(8) Exploitative Capabilities	Pearson Correlation	0.18	0.11	-0.03	-0.02	0.15	0.46*	0.49	1			
	Sig. (2-tailed)	0.06	0.25	0.78	0.81	0.12	0.00	0.00				
(9) The Success Trap	Pearson Correlation	0.07	0.22*	-0.51**	-0.26**	-0.28**	-0.58**	-0.43**	-0.21	1		
	Sig. (2-tailed)	0.45	0.02	0.00	0.01	0.00	0.00	0.00	0.03			
(10) Market Dynamism	Pearson Correlation	-0.06	-0.13	0.10	0.03	0.05	0.03	0.10	0.08	-0.04	1	
	Sig. (2-tailed)	0.52	0.18	0.28	0.72	0.62	0.77	0.32	0.39	0.69		
(11) Firm Performance	Pearson Correlation	0.00	0.03	-0.02	0.20*	-0.02	0.18	0.17	0.21*	-0.08	-0.06	1
	Sig. (2-tailed)	0.99	0.73	0.83	0.03	0.87	0.05	0.07	0.03	0.39	0.55	

NOTE: **. Correlation is significant at the 0.01 level (2-tailed); *. Correlation is significant at the 0.05 level (2-tailed); N = 113

Appendix 11: Harman's One Factor Test: Total Variance Explained

Component	Initial Eigenvalues[a]			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	18.35	21.51	21.51	18.35	21.51	21.51	8.92	10.45	10.45
2	6.69	7.84	29.35	6.69	7.84	29.35	6.41	7.51	17.96
3	5.69	6.67	36.01	5.69	6.67	36.01	5.51	6.46	24.42
4	4.98	5.84	41.85	4.98	5.84	41.85	5.94	6.96	31.38
5	4.67	5.48	47.33	4.67	5.48	47.33	4.90	5.74	37.12
6	3.71	4.35	51.68	3.71	4.35	51.68	4.36	5.11	42.23
7	3.37	3.95	55.63	3.37	3.95	55.63	4.73	5.54	47.77
8	3.05	3.57	59.20	3.05	3.57	59.20	4.12	4.82	52.60
9	2.67	3.13	62.34	2.67	3.13	62.34	3.56	4.17	56.77
10	2.50	2.93	65.27	2.50	2.93	65.27	3.27	3.83	60.60
11	2.39	2.80	68.06	2.39	2.80	68.06	4.17	4.89	65.49
12	2.24	2.62	70.69	2.24	2.62	70.69	2.54	2.98	68.47
13	2.11	2.47	73.16	2.11	2.47	73.16	4.00	4.69	73.16
14	1.78	2.08	75.24						
15	1.74	2.04	77.27						
16	1.60	1.87	79.15						
17	1.55	1.81	80.96						
18	1.46	1.71	82.67						
19	1.39	1.63	84.29						
20	1.29	1.51	85.80						
21	1.21	1.42	87.22						
22	1.17	1.37	88.59						
23	1.03	1.21	89.80						
24	1.01	1.18	90.98						
25	0.97	1.13	92.12						
26	0.80	0.94	93.05						
27	0.72	0.85	93.90						
28	0.68	0.79	94.69						
29	0.66	0.78	95.46						
30	0.55	0.64	96.10						
31	0.54	0.63	96.73						
32	0.48	0.57	97.30						
33	0.42	0.49	97.79						
34	0.37	0.44	98.22						
35	0.34	0.40	98.62						
36	0.26	0.30	98.92						
37	0.26	0.30	99.22						
38	0.22	0.26	99.48						
39	0.21	0.25	99.73						
40	0.16	0.18	99.91						
41	0.08	0.09	100.00						

NOTE: Extraction Method: Exploratory Factor Analysis; a. When analyzing a covariance matrix, the initial eigenvalues are the same across the raw and rescaled solution.

Appendix 12: Item Correlation Matrices

Correlation Matrix: The Success Trap

		ST1	ST3	ST4	ST5
ST1	Rather than trying to move into new technologies, this firm has been relying on a set of familiar technologies	1			
ST3	This firm has been focussing on solving problems mainly through further development of mature technologies	0.39**	1		
ST4	This firm prefers to adopt technologies which are well-established in the industry rather than untested technologies in the industry	0.45**	0.54**	1	
ST5	The tendency of this firm to look for solutions closer to existing technologies in the industry has been a barrier to develop pioneering solutions	0.39**	0.34**	0.39**	1

NOTE: ** Correlation is significant at the 0.01 level (2-tailed); * Correlation is significant at the 0.05 level (2-tailed).

Correlation Matrix: Market Dynamism

		MD1	MD2	MD3	MD4	MD5	MD6
MD1	The actions of local and foreign competitors in our major markets were changing quite rapidly.	1					
MD2	Technological changes in our industry were rapid.	0.38**	1				
MD3	Technological changes in our industry were unpredictable.	0.27**	0.34**	1			
MD4	The market competitive conditions were highly unpredictable.	0.33**	0.03	0.42**	1		
MD5	Customers' product preferences changed quite rapidly.	0.33**	0.31**	0.34**	0.35**	1	
MD6	Changes in customers' needs were quite unpredictable.	0.20*	0.17	0.29**	0.43**	0.49**	1

NOTE: ** Correlation is significant at the 0.01 level (2-tailed); * Correlation is significant at the 0.05 level (2-tailed).

Correlation Matrix: Dynamic Capabilities

		DC1	DC2	DC3	DC4	DC5	DC6	DC7	DC8	DC9	DC10	DC11
DC1	People in this firm are encouraged to challenge outmoded practices.	1										
DC2	This firm is flexible enough to allow us to respond quickly to changes in our markets.	0.39**	1									
DC3	This firm evolves rapidly in response to shifts in our business priorities.	0.44**	0.80**	1								
DC4	This firm has a clear division of roles and responsibilities for acquiring new knowledge.	0.29**	0.33**	0.30**	1							
DC5	This firm has the necessary skills to implement newly acquired knowledge.	0.38*	0.46**	0.40**	0.40**	1						
DC6	This firm has the competences to transform the new acquired knowledge.	0.35*	0.47**	0.42**	0.31**	0.83**	1					
DC7	This firm has the competences to use the new acquired knowledge.	0.28*	0.47**	0.43*	0.31**	0.76**	0.89**	1				
DC8	This firm introduces improvements and innovations in our business.	0.38*	0.48**	0.54**	0.25**	0.41**	0.43**	0.41**	1			
DC9	This firm is creative in its methods of operation.	0.39*	0.57**	0.58**	0.39**	0.37**	0.34**	0.34**	0.64**	1		
DC10	This firm seeks out new ways of doing things.	0.56*	0.62**	0.68**	0.33**	0.38**	0.39**	0.37**	0.64**	0.75*	1	
DC11	People in this firm get a lot of support from managers if we want to try new ways of doing things.	0.52*	0.60**	0.60**	0.26**	0.34**	0.33**	0.38**	0.55**	0.58**	0.64**	1

NOTE: ** Correlation is significant at the 0.01 level (2-tailed).

Correlation Matrix: Exploratory Capabilities

		EXPLOR1	EXPLOR2	EXPLOR3	EXPLOR4	EXPLOR5
EXPLOR1	Acquired manufacturing technologies and skills entirely new to the firm.	1				
EXPLOR2	Learned product development skills and processes entirely new to the industry	0.44**	1			
EXPLOR3	Acquired entirely new managerial and organizational skills that are important for innovation?	0.32**	0.21*	1		
EXPLOR4	Learned new skills in areas such as funding new technology, staffing R&D function, training and development of R&D, and engineering personnel for the first time.	0.25**	0.25**	0.47**	1	
EXPLOR5	Strengthened innovation skills in areas where it had no prior experience.	0.19*	0.37**	0.29**	0.52**	1

NOTE: ** Correlation is significant at the 0.01 level (2-tailed); * Correlation is significant at the 0.05 level (2-tailed).

Correlation Matrix: Exploitative Capabilities

		EXPLOIT1	EXPLOIT2	EXPLOIT3	EXPLOIT4	EXPLOIT5
EXPLOIT1	Upgraded current knowledge and skills for familiar products and technologies.	1				
EXPLOIT2	Invested in enhancing skills in exploiting mature technologies that improve productivity of current innovation operations.	0.54**	1			
EXPLOIT3	Enhanced competencies in searching for solutions to customer problems that are near to existing solutions rather than completely new solutions.	0.39**	0.55**	1		
EXPLOIT4	Upgraded skills in product development processes in which the firm already possesses significant experience.	0.38**	0.33**	0.36**	1	
EXPLOIT5	Strengthened its knowledge and skills for projects that improve efficiency of existing innovation activities.	0.37**	0.43**	0.47**	0.63**	1

NOTE: ** Correlation is significant at the 0.01 level (2-tailed); * Correlation is significant at the 0.05 level (2-tailed).

Correlation matrix: Firm performance

		FP1	FP2	FP3	FP4
FP1	Sales growth	1			
FP2	Growth in profitability	0.69**	1		
FP3	Increase in the number of employees	0.50**	0.39**	1	
FP4	Increase in the size of business premises	0.03	-0.02	0.43**	1

NOTE: ** Correlation is significant at the 0.01 level (2-tailed); * Correlation is significant at the 0.05 level (2-tailed).

Appendix 13: One-way ANOVA for Key Continuous Variables

One-Way ANOVA for Key Continuous Variables: Test of Homogeneity of Variances

	Firm Size vs. the Key Continuous Variables				Firm Age vs. the Key Continuous Variables				Industry Type vs. the Key Continuous Variables			
	Levene Statistic	**df1**	**df2**	**Sig.**	**Levene Statistic**	**df1**	**df2**	**Sig.**	**Levene Statistic**	**df1**	**df2**	**Sig.**
The Success Trap	0.09	2	110	0.91	1.37	3	109	0.25	0.94	4	108	0.44
Market Dynamism	1.06	2	110	0.35	0.13	3	109	0.94	1.90	4	108	0.12
Dynamic Capabilities	0.19	2	110	0.83	1.84	3	109	0.14	2.17	4	108	0.08
Exploratory Capabilities	0.54	2	110	0.59	0.78	3	109	0.51	2.33	4	108	0.06
Exploitative Capabilities	0.45	2	110	0.64	0.27	3	109	0.85	0.06	4	108	0.99
Firm Performance	2.07	2	110	0.13	1.20	3	109	0.32	0.60	4	108	0.66

One Way ANOVA for the Key Continuous Variables: Mean Values

	Firm Size			Firm Age				Industry Type				
	Micro	**Small**	**Medium**	**New**	**Young**	**Adult**	**Old**	**Aerospace**	**Pharmaceutical and Biotech**	**Office and Computing**	**Radio, TV and Communication**	**Medical and Optical Equipment**
The Success Trap	3.48	3.63	3.81	3.53	3.46	3.71	3.79	3.95	3.84	3.66	3.39	3.71
Market Dynamism	4.06	4.04	4.00	3.97	4.38	4.08	3.85	3.68	4.03	4.26	4.03	3.90
Dynamic Capabilities	5.44	5.51	5.17	5.52	5.40	5.49	5.12	4.88	5.34	5.50	5.39	5.43
Exploratory Capabilities	4.31	4.18	4.59	4.49	3.99	4.37	4.47	3.95	4.33	4.20	4.58	4.69
Exploitative Capabilities	4.89	4.88	5.17	4.81	4.80	5.08	5.10	4.66	5.09	5.07	5.07	5.01
Firm Performance	4.12	4.74	4.31	4.54	4.41	4.33	4.53	4.55	4.84	4.49	4.07	4.51

ANOVA for Firm Size vs. Firm Performance (Multiple Comparisons)

					95% Confidence Interval	
(I) Firm Size	**(J) Firm Size**	**Mean Difference (I-J)**	**Std. Error**	**Sig.**	**Lower Bound**	**Upper Bound**
Micro	Small	-0.62*	0.25	0.04	-1.21	-0.03
	Medium	-0.19	0.25	0.72	-0.78	0.40
Small	Micro	0.62	0.25	0.04	0.03	1.21
	Medium	0.43	0.20	0.10	-0.06	0.91
Medium	Micro	0.19	0.25	0.72	-0.40	0.78
	Small	-0.43	0.20	0.10	-0.91	0.06

NOTE: *. The mean difference is significant at the p <0.05 level.

Appendix 14: Initial EFA Results for the Market Dynamism Construct (Rotated Component Matrix[a])

		Component	
		1	2
MD1	The actions of local and foreign competitors in our major markets were changing quite rapidly.		0.68
MD2	Technological changes in our industry were rapid.		0.10
MD3	Technological changes in our industry were unpredictable.	0.51	0.46
MD4	The market competitive conditions were highly unpredictable.	0.82	
MD5	Customers' product preferences changed quite rapidly.	0.62	0.40
MD6	Changes in customers' needs were quite unpredictable.	0.78	

NOTE: Extraction Method: Exploratory Factor Analysis; Rotation Method: Varimax with Kaiser Normalization; a. Rotation converged in 3 iterations.

Appendix 15: Collinearity Statistics

Hypothesis	*Variable*	*Model 1*		*Model 2*	
		Tolerance	**VIF**	**Tolerance**	**VIF**
H_1	(Constant)				
	Firm Size	0.64	1.56	0.64	1.57
	Firm Age	0.64	1.57	0.63	1.60
	R & D Intensity	0.61	1.64	**0.52**	**1.93**
	Marketing Intensity	0.78	1.28	0.78	1.28
	Number of patents	0.75	1.33	0.75	1.33
	The Success Trap			0.73	1.38
H_2	(Constant)				
	Firm Size	0.64	1.56	0.64	1.56
	Firm Age	0.64	1.57	0.63	1.59
	R & D Intensity	0.61	1.64	0.61	1.64
	Marketing Intensity	0.78	1.28	0.78	1.28
	Number of patents	0.75	1.33	0.75	1.33
	Market Dynamism			0.98	1.02
H_3	(Constant)				
	Firm Size	0.64	1.56	0.64	1.57
	Firm Age	0.64	1.57	0.63	1.59
	R & D Intensity	0.61	1.64	0.59	1.71
	Marketing Intensity	0.78	1.28	0.78	1.28
	Number of patents	0.75	1.33	0.75	1.33
	Dynamic Capabilities			0.89	1.12
H_4	(Constant)				
	Firm Size	0.64	1.56	0.64	1.57
	Firm Age	0.64	1.57	0.63	1.59
	R & D Intensity	0.61	1.64	0.59	1.71
	Marketing Intensity	0.78	1.28	0.78	1.28
	Number of Patents	0.75	1.33	0.75	1.33
	Dynamic Capabilities			0.89	1.12
H_6	(Constant)				
	Firm Size	0.64	1.56	0.64	1.57
	Firm Age	0.64	1.57	0.63	1.58
	R & D Intensity	0.61	1.64	0.59	1.69
	Marketing Intensity	0.78	1.28	0.78	1.28
	Number of patents	0.75	1.33	0.74	1.37
	Exploratory Capabilities			0.88	1.14
H_7	(Constant)				
	Firm Size	0.64	1.56	0.63	1.58
	Firm Age	0.64	1.57	0.64	1.58
	R & D Intensity	0.61	1.64	0.61	1.64
	Marketing Intensity	0.78	1.28	0.78	1.28
	Number of patents	0.75	1.33	0.74	1.35
	Exploitative Capabilities			0.95	1.05

NOTE: Collinearity statistics for H_5 that was tested employing Pearson's correlation analysis are not available.

Appendix 16: The Code Book

Concept	Code	Definition of the Code	Related Hypothesis
THE SUCCESS TRAP	ST		*H_1:The success trap has a negative influence on dynamic capabilities of a firm.*
ST:Familiarity trap	ST-FAM	A tendency to favour the familiar over the unfamiliar.	
ST:Maturity trap	ST-MAT	A tendency to prefer the mature over the nascent.	
ST: Propinquity trap.	ST-PRO	A tendency to search for solutions that are near to existing solutions rather than search for completely new solutions.	
ST:Other	ST-OTHER	Other ST related data	
MARKET DYNAMISM	MD		*H_2 :Market dynamism has a positive influence on dynamic capabilities of a firm.*
MD:Technology	MD-TEC	Change in production/service technology	
MD:Competition	MD-COM	Competitive intensity	
MD:Customer	MD-CUS	The general rate of change in an industry	
MD:Other	MD:OTHER	Other MD related data	
DYNAMIC CAPABILITIES	DC		*H_3 :Dynamic capabilities have a positive relationship with exploratory capabilities of firms.*
DC:Adaptive capability	DC-ADCAP	The capacity to reconfigure activities in the business unit quickly to meet changing demands in the task environment.	
DC:Absorptive capability	DC-ABCAP	The ability of a firm to recognize the value of new information, assimilate it, and apply to commercial ends.	
DC:Innovative capability	DC-INCAP	Capability in introducing new products and production-service technologies, the searching for novel solutions to marketing and production problems, and attempting to lead rather than to follow competitors.	
DC-Other general	DC-GEN	General DC related data (e.g. how the firm develop and use DCs.)	
ENTREPRENEURIAL CAPABILITIES	EC		*H_3 :Dynamic capabilities have a positive relationship with exploratory capabilities of firms.* *H_4 :Dynamic capabilities have a positive relationship with exploitative capabilities.* *H_5:Exploratory capabilities and exploitative capabilities of firms are positively correlated.*
EC:Exploratory capability	EC-EXPLOR	Exploratory capabilities imply firm capabilities related to search, discovery, experimentation, risk taking and innovation.	
EC:Exploitative capability	EC-EXPLOIT	Exploitative capabilities imply firm capabilities related to refinement, implementation, efficiency, production and selection.	
FIRM PERFROMANCE	FP		*H_6 :Exploratory capabilities are positively related to firm performance.* *H_7 :Exploitative capabilities are positively related to firm performance.*
FP:Financial performance	FP-FIN	Performance indicated by sales, profitability, and other financial measures.	
FP:Non-financial performance	FP-NFIN	Performance indicated by number of employees, size of premises, and other non-financial measures.	
HYPOTHESISED CAUSAL LINKS			
Market dynamism and dynamic capabilities	MD/DC	N/A	*H_2 :Market dynamism has a positive influence on dynamic capabilities of a firm.*
The success trap and dynamic capabilities	LT/DC	N/A	*H_1:The success trap has a negative influence on dynamic capabilities of a firm.*
Dynamic capabilities and exploratory capabilities	DC/EC-EXPLOR	N/A	*H_3 :Dynamic capabilities have a positive relationship with exploratory capabilities of firms.*
Dynamic capabilities and exploitative capabilities	DC/EC-EXPLOIT	N/A	*H_4 :Dynamic capabilities have a positive relationship with exploitative capabilities.*
Exploratory capabilities and exploitative capabilities	EXPLOR - EXPLOIT		*H_5:Exploratory capabilities and exploitative capabilities of firms are positively correlated.*
Entrepreneurial capabilities and firm performance	EC-EXPLOR/FP	N/A	*H_6 :Exploratory capabilities are positively related to firm performance.*
	EC-EXPLOIT/FP	N/A	*H_7 :Exploitative capabilities are positively related to firm performance.*
CHALLENGES	CH	Challenges faced by the firm in achieving its goals.	*These data are aimed at identifying the level of dynamic capabilities of the firm.*
STRATGEIES	ST	How the firm is going to cope with the challenges.	
RESOURCES/CAPABILITIES	RESCAP	Resources or capabilities required to meet the challenges.	

Appendix 17: The Data Structure

1st Concept	*2nd Theme*	*Aggregate Dimension*
• Firms may stick to what they know due to resource constraints • People in firms are more comfortable with what is familiar. • Firms rely on familiar technologies as they want to be more customer focused.	*Familiarity trap*	Internal antecedent of dynamic capabilities: the success trap
• Difficulty in getting to the market makes high-tech SMEs stick to the mature technology. • Sticking to the mature technology is the nature of the SME's business.	*Maturity trap*	
• Not understanding market needs (Not sure if there is a market for something g radically new). • Changing core technology carries a bigger risk. • The belief that firms can innovate while adopting the established core technology. • Over relying on customer feedback may put a firm in a trap.	*Propinquity trap*	
• Firms let customers play an important role in developing their products. • The real (standard) customer needs do not change rapidly. • Change of needs depends on the types of customer. • Creating a niche market help control change in customer preferences.	*Change in customer behaviour*	External antecedent of dynamic capabilities: market dynamism
• The level of rapidness in technological changes varies across different types of high-tech industries. • Technological changes can be unpredictable due to other factors.	*Change in technology*	
• Competitive conditions can be industry specific. • Technology drives competitive condition. • Competitor actions can vary within the same high-tech industry. • Strategic moves may be driven by being small. • Lesser the number of competitors, predictability of their actions is high.	*Change in competition*	
• Small firms may not have a clear vision for acquiring new knowledge. • Search for scientific literature and Collaborating with academics can be a main source of new knowledge. • Collaborating with suppliers/industry partners can be a main source of new knowledge. • Customers can be a main source of knowledge for small firms. • Small firms may use informal mechanisms to assimilate new knowledge. • Using formal mechanisms in assimilating new knowledge. • Using internal expertise (developing skills of existing people and hiring people with skills).	*Absorptive capability*	Dynamic capabilities
• People are encouraged to challenge the status quo. • Flexible enough to respond. • Evolving in response to business priorities. • Introducing improvements and innovation in the business. • Creative in methods of operation (possesses required resources to be creative). • Seeking out new solutions. • Lack of resources may restrict innovation.	*Transformative capability*	
• Acquiring manufacturing technologies and skills entirely new to the firm. • Learning product development skills and processes entirely new to the industry. • Acquiring entirely new managerial and organizational skills. • Learning new skills in areas such as funding new technology, staffing R&D function, training and development of R&D, and engineering personnel for the first time. • Strengthening innovation skills in areas where it had no prior experience. • Number of patents may not be a good indicator of exploratory capability of small firms.	*Acquire entirely new knowledge, skills, and processes.*	Entrepreneurial capabilities :exploratory capabilities
• Upgrading current knowledge and skills for familiar products and technologies. • Investing in enhancing skills in exploiting mature technologies that improve productivity of current innovation operations. • Enhancing competencies in searching for solutions to customer problems that are near to existing solutions rather than completely new solutions. • Upgrading skills in product development processes in which the firm already possesses significant experience. • Strengthening knowledge and skills for projects that improve efficiency of existing innovation activities. • Focusing more on the exploiting existing markets. • Small firms adopt a unique approach in marketing.	*Refine and extend existing knowledge, skills, and processes.*	Entrepreneurial capabilities: exploitative capabilities
• Sales • Profitability	*Financial performance*	Firm performance
• Employees • Space	*Non-financial performance*	